MAR 5 1928

The Engineer.

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The Engineer

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PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 2nd March, 1928, for LOW-PRESSURE HOT WATER HEATING at the Post Office, &c., Horsham.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7783

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—375 TONS STEEL, B.H., 100 lb. RAILS, Half to be of Chrome Steel.

SCHEDULE 2.—LOCOMOTIVE BOILERS, LOCOMOTIVE CYLINDERS, and other EQUIPMENT.

Tenders due on the 28th February, 1928, for No. 1, and on the 9th March, 1928, for No. 2.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 7794

Assistant Engineers (10) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 35 years of age, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. Must have had proper technical training and preferably have had not less than two years' subsequent experience on large Engineering or Municipal Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/254. 7748

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 28, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtain such other diploma or distinction in engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience, and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 7762

Executive Engineer REQUIRED by the GOVERNMENT of TANGANYIKA for the PUBLIC WORKS DEPARTMENT for a tour of 20 to 30 months, with possible extension. Salary £720, rising to £840 a year by annual increments of £30. Free quarters and passages and liberal leave on full salary. Candidates, preferably unmarried, not over 45 years of age, must be Chartered Civil Engineers, who have been regularly trained in an office of an engineer carrying out Water and Sewerage Schemes, and must subsequently have had at least five years' experience in the construction of such works. Previous tropical experience very desirable.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15407. 7763

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for :—

A. 3100 STEEL CARRIAGE and WAGON TYRES.
B. 300 STEEL LOCO. TYRES.
C. 1415 AXLE-BOXES and FITTINGS.
D. 11,300 VOLUTE SPRINGS.
E. 5350 C.I. BEARINGS (White Metal Lined).
F. 2200 WAGON and CARRIAGE FORGINGS.
G. 4791 STEEL BOILER TUBES.
H. 100 COPPER FIRE-BOX PLATES.
I. 349,000 FISH BOLTS and NUTS.

A fee of 20s. will be charged for Specification A, and of 10s. each for Specifications B to I inclusive, which is not returnable.

Tenders must be submitted not later than Noon on Tuesday, 28th February, 1928.

The Directors do not bind themselves to accept the lowest or any Tenders, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
R. C. VOLKERS,
Secretary.
10th February, 1928. 7740

PUBLIC NOTICES

THE SIR JOHN CASS TECHNICAL INSTITUTE,
Jewry Street, Aldgate, E.C. 3.

Course of Six Lectures on Thursday evenings at 7 p.m., commencing February 23rd.

FUEL TECHNOLOGY.

BOILER FUELS AND BOILER ECONOMY.
LIQUID FUEL.
Eng.-Rear-Admiral A. E. HYNE, C.M.G. (Retd.).
GASEOUS FUEL.
W. A. TOOKEY, M.I.Mech.E., M.I.A.E.
SOLID AND POWDERED FUEL.
B. SAMUELS, M.I.Mech.E.
MODERN PLANT AND WORKING.
W. H. PATCHELL, Past. Pres. Inst. Mech. E.

Fee for the full Course - - 20s.

Syllabus on application to GEO. PATCHIN, Principal.

Stations :—Aldgate (Met.), Mark Lane.
Bus Routes :—5, 10, 15, 23, 25, 40, 42, 78, 96, 125.

The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for TWO 1-TON ELECTRIC TRUCKS and CHARGING PANELS.—Full particulars with form of Tender may be obtained from J. L. GOLDSPINK, Clerk to the Guardians, Guardians' Offices, Brook-street, Kennington-road, S.E. 11.
14th February, 1928. 7777

SITUATIONS OPEN

ENGINEER for Small Waterworks, Uckfield.—Will the Applicants for this Post kindly accept this intimation that the POST has been FILLED? 7769 A

PUBLIC NOTICES

Administrative County of LONDON.
SCAVENGING, &c., OF THAMES EMBANKMENTS AND BRIDGES.

The London County Council invites TENDERS for the SCAVENGING, &c., of the THAMES EMBANKMENTS and BRIDGES for a period of twelve months, commencing 1st April, 1928.

The form of Tender, &c., may be obtained on application to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £1 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

Correspondence and remittances by post should be addressed to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, or, if personal application is made, applicants should apply in Room 3A at No. 8, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 27th February, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
7779 Clerk of the London County Council.

Mersey Docks and Harbour BOARD.
ENGINEER-IN-CHIEF.

The Mersey Docks and Harbour Board invite APPLICATIONS for the POSITION of ENGINEER-IN-CHIEF to the Board, which will be vacant at the end of June.

Candidates, who should be under 50 years of age, must be Members of the Institution of Civil Engineers and have had good experience in Dock and Harbour Construction and Maintenance and also in Estuary and River Training Works.

Applications, stating salary required, age, qualifications and experience, accompanied by copies of not more than three recent testimonials, to be sent to the undersigned not later than March 31st, 1928.

L. A. P. WARNER,
General Manager and Secretary.
Dock Office, Liverpool,
January 9th, 1928. 7454

PUBLIC NOTICES

Skegness Urban District Council.
ELECTRICITY PLANT.

Firms desiring to TENDER for the SUPPLY and INSTALLATION of the above should apply for specifications to Mr. R. H. Jenkins, M.I.M. & C.E., Engineer and Surveyor, Council Offices, Skegness, giving particulars of work previously carried out, and not less than three references, on or before Wednesday, February 29th, 1928.

IVOR M. CULE,
Clerk to the Council.
Council Offices, Skegness,
15/2/28. 7793

Shaughai Municipal Electricity DEPARTMENT.
STAFF APPOINTMENTS.

The Electricity Department of the Council invites APPLICATIONS from qualified Engineers for the POSITION of CHIEF ASSISTANT ENGINEER in the Department.

The engagement is, under the first appointment, for a period of three years, but the appointment holds good prospects of promotion to a more senior office.

Salary for the first three years will be Taels 1900 per month, which at the present rate of exchange (Tael 1 equals 2s. 6d.) is approximately £1900 per annum.

First-class passage out and home, also for wife if applicant is married.

Free medical attention and participation in Superannuation Fund and Pension Scheme.

It is essential that applicants must either now or recently have held office as Deputy Chief Engineer or Chief Assistant Engineer in an Electricity Supply Undertaking, preferably in a large one, or a responsible position in one of the larger companies manufacturing equipment used in such undertakings.

It is desirable that candidates should not be over 40 years of age, but an exception might be made if the candidate's qualifications justify an extension of the age limit.

Applications should be submitted in writing (only), giving full particulars regarding age, education, training, subsequent experience and present position held, and forwarded to the undersigned, c/o Messrs. Preece, Cardew and Rider, 3, Queen Anne's gate, London, S.W. 1, not later than Wednesday, February 29th, 1928. Envelopes should be endorsed "Chief Assistant Engineer."

T. H. U. ALDRIDGE,
M.I.E.E., M.I. Mech. E., Fel. A.I.E.E.,
Engineer-in-Chief and Manager.
16th February, 1928. 7742

Shanghai Municipal Electricity DEPARTMENT.
STAFF APPOINTMENT.
ASSISTANT SECRETARY.

The notification issued in October last inviting APPLICATIONS for the above POST having failed to attract suitable candidates, the Electricity Department is PREPARED to INCREASE the SALARY then offered from Taels 700 per month to Taels 800 per month.

The commencing salary for this appointment will be Taels 800 per month for the first agreement of three years, which at the average rate of exchange (Tael equals 2s. 9d.) is equivalent approximately to £1200 per annum plus superannuation and pension benefits.

It is customary for agreements to be renewed every three years at an increased salary up to a maximum within the grade relating to the office held.

It should be noted that municipal employees are exempt from local rates and taxes in Shanghai and are free from British Income Tax.

The position is one of major responsibility, and it is most desirable that applicants should have held senior positions in other electricity supply undertakings; be capable of directing and controlling a large clerical staff; have an intimate knowledge of the technicalities of the business; and possess initiative, tact and good personality.

The Department operates on semi-company lines and the secretarial duties are therefore very similar to those attaching to service with a company undertaking. Previous experience with committee work is desirable, but not altogether essential.

GENERAL INFORMATION, &C.—Free first-class passages, both out and home, will be provided. In the event of the selected candidate being married, wife's passage will be provided under conditions which will be explained.

Candidates for this appointment should preferably be between 30 and 35 years of age, but the limit might be extended up to 40 if the candidate's qualifications are exceptionally good.

Free medical and hospital treatment is provided for employees, wives and children.

Applications should be submitted in writing (only), giving full particulars regarding age, education, training, subsequent experience, and present position held, and forwarded to the undersigned, c/o Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, London, S.W. 1, not later than Wednesday, the 29th February, 1928. Envelopes should be endorsed "Assistant Secretary."

T. H. U. ALDRIDGE,
M.I.E.E., M.I. Mech. E., Fel. A.I.E.E.,
Engineer-in-Chief and Manager.
16th February, 1928. 7747

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PUBLIC NOTICES

Applications are Invited (by letter only) from properly qualified candidates for APPOINTMENT to the following VACANCY:—
JUNIOR ASSISTANT ELECTRICAL ENGINEER.
Candidates must have had good experience of erection contracts for Power-houses and General Electrical Plant. Age up to 30 years; unmarried man preferred. Salary £450, rising to £550 per annum. Second-class free passage to Malaya and home again on satisfactory termination of services. The selected candidate will be required to pass a strict medical examination before appointment. Applicants must give particulars of their general and technical education and a detailed record of their practical training and subsequent experience with dates in each case, names of employers from time to time and the class of work carried out, together with copies only of testimonials, which cannot be returned. Letters should be addressed to the undersigned not later than 24th February, 1928.
RENDEL, PALMER & TRITTON,
Appointments Department,
7764 13, Dartmouth-street, Westminster, S.W. 1.

Government of Northern IRELAND.
MINISTRY OF FINANCE.
CIVIL ENGINEERING APPOINTMENTS.
APPLICATIONS are INVITED for the following VACANCIES:—TWO TEMPORARY ASSISTANT CIVIL ENGINEERS. Salary from £5 to £8 per week, in accordance with qualifications and experience. Practical experience of problems relating to Arterial Drainage and Hydraulics is desirable. TWO TEMPORARY CIVIL ENGINEERING DRAUGHTSMEN. Salary from £4 10s. to £6 per week, in accordance with qualifications and experience. Experience in the preparation of Contract Drawings, Quantity Surveying and Estimating is essential. The probable duration of the appointments is not less than twelve months.—Applications must be made on the prescribed form, which can be obtained from the SECRETARY, Ministry of Finance (Establishment Division), 15, Donegall-square West, Belfast, and must be returned so as to reach the Secretary not later than the 29th February, 1928. 7741

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by Leading Engineering Insurance Company, additional INSPECTORS, fully qualified in best Crane and Lift Practice. Age 28 to 32. Commencing salary £260 per annum.—Address, with full particulars of experience, age, &c., 7751, The Engineer Office. 7751 A

WANTED, ENGINEER MANAGER for Sugar and Almond Mill and Jam and Peel Factory. Must be capable of the design and supervision of the making of special machines. Used to control of various classes of labour.—Apply, giving age, with copies of qualifications, to BURTON, SON and SANDERS, Ltd., Ipswich. 7778 A

WANTED for India, ENGINEER SALESMAN, conversant with Air Compressing and Pneumatic Plant for mining and workshop use; age not over 26; must be single.—State fullest details of education, experience, present work and salary, to Z.W. 148, c/o Deacon's Advertising Agency, Fenchurch-avenue London, E.C. 3. 7761 A

WANTED for Oil Engine Works About 60 Miles from London, ASSISTANT WORKS MANAGER; good shop experience essential, marine experience useful. Good future for suitable man.—Address, stating qualifications, 7770, The Engineer Office, 7770 A

WANTED, GENERAL MANAGER of Old-established Works manufacturing high-class Electrical Cranes, Steel Structures, and Electrical Plant. Applicant must be hard worker, tactful, and good organiser. Experience in design and economical production essential. Full recognition will be given for good results.—Write, stating age, experience, and salary required, to Box W302, Harrison and Sons, Ltd., 45-47, St. Martin's-lane, London, W.C. 2. 7754 A

WANTED, MAN to Take Charge Preparation of Advertisements, Catalogues, and Publicity Literature for Specialist Engineering Firm, preferably with technical training and publicity experience. Good position suitable man.—Address, "PUBLICITY," Williams Porteous and Co., Advertising Agents, Glasgow. P4125 A

WANTED, REPRESENTATIVES for Sale Chain Pulley Blocks and Runway Trolleys in North and South. Good commission.—Address, P4162, The Engineer Office. P4162 A

A LARGE STEEL WORKS REQUIRE the SERVICES of a YOUNG ENGINEER, age about 25 years, in their Tool Dept. Good general and technical education essential. Replies should state fully past experience and training.—Address, 7749, The Engineer Office. 7749 A

AN ENGINEERING FIRM REQUIRE in their London office a capable qualified ENGINEER, about 35 years of age, to Take Charge of Small Drawing-office with very varied work. Must have experience in Designing Vessels in Steel and Non-ferrous Metals and able to Estimate and Order Material. Will also be required to inspect plant in course of construction. Only applicants with above qualifications and capable of holding a post of responsibility need apply.
Address, stating in detail qualifications, training, works experience, age, salary required, &c., P4168, The Engineer Office. P4168 A

ASSISTANT ENGINEER REQUIRED for Engineering Department (Power-house Plants) at our Baden Works. Applicants must possess engineering degree or first-class diploma and practical experience in works and steam turbine power-house and/or on turbine test beds. Age 25-30.—Full particulars to SECRETARY, Brown Boveri and Company, Baden-Aargau, Switzerland. 7553 A

ENGINEER (MECHANICAL) REQUIRED, to Take Charge of all Plant and Machinery other than Electrical at large modern Steel Tube Works. Must be fully experienced in the economical running and maintenance of Steam, Hydraulic, and Pneumatic Power Installations, Rolling Mills, Large and Small Machine Tools, Steam Locomotives, and all General Engineering matters. Capable of supervising engineering foremen and skilled workmen. Only thoroughly capable and experienced men need apply with full particulars of training, past experience, and salary expected.—Address, 7754, The Engineer Office. 7754 A

ENGINEER SALESMAN REQUIRED, Resident London, for Centrifugal Oil Purifiers; must be expert salesman with technical knowledge essential. Salary and commission.—Address, 7662, The Engineer Office. 7662 A

FIRST-CLASS MECHANICAL DESIGNER REQUIRED, London district; ability and good qualifications essential.—Address, P4180, The Engineer Office. P4180 A

LONDON SALES MANAGER WANTED, with Good business experience. Sound knowledge of Workshop Equipment essential. Directorship available good type man. Investment.—Write, Box 882, Sells, Fleet-street, E.C. 4. 7780 A

MANAGER for Aluminium Foundry WANTED by a London Company. Only those who are fully experienced in the making of intricate Castings need apply. Good salary offered.—Address, stating age, details of experience, giving names and addresses of firms and dates of employment, also salary required, 7787, The Engineer Office. 7787 A

REQUIRED for Central Power Station, Chile, Competent ENGINEER, bachelor, first-class specialist Diesel Engines and Electricity.—Address full particulars, age, qualifications, &c., P4160, The Engineer Office. P4160 A

SITUATIONS OPEN (continued)

REQUIRED by Important Agricultural Machinery Works, Paris District, CHIEF ENGINEER, 30/40 years, capable Taking Entire Charge Millwrights, Mechanical, Tooling, Electricians' Departments, and General Engineering Works organisation, where latest methods are employed for mass production. Only first-class men need apply. Excellent prospects. Only applications giving fullest details considered. State what knowledge French.—DORLAND, Box 243, 65-67, Avenue des Champs-Elysees, Paris. 7789 A

REQUIRED for London Area ENGINEER SALESMAN, conversant with Consulting Engineers and Transformer Purchasers.—Address, with full details as to salary, experience, age, &c., 7750, The Engineer Office. 7750 A

SUPT. of DEPT. WANTED, to Control Jig and Tool Design and Manufacture, Processing and Rate-fixing. High salary paid to a good man.—Address, stating age, experience, and where such has been gained, 7788, The Engineer Office. 7788 A

SYNTHETIC AMMONIA and NITRATES, Ltd. (Associated with Imperial Chemical Industries, Ltd.), REQUIRE the SERVICES of MECHANICAL ENGINEERS, age 25-32. Applicants must possess first-class practical experience, and must have had University or similar technical training. Previous experience on Machine Design and Lay-out Work essential.
The work to be undertaken is the design of works plant.
Duties will commence in the drawing-office, but promotion and salary will be entirely dependent upon ability and personality.
Replies to be addressed to the CHIEF ENGINEER, Synthetic Ammonia and Nitrates, Ltd., Billingham, Stockton-on-Tees. 7719 A

YOUNG MAN, with Engineering Experience and general knowledge of factory conditions, WANTED by large Gas Company, to ensure proper and fullest use of gas for industrial purposes; must have good address and preferably a University Degree. Applications treated confidentially.—Address, 7753, The Engineer Office. 7753 A

YOUNG MECHANICAL ENGINEER, University Graduate, with two or three years' office and outside experience on Power and Maintenance, for PERMANENT POSITION on the Continent, to work under the production manager in maintaining property, promoting efficiency, &c., in several widely scattered plants. State age, full details, and salary required.—Address, 7755, The Engineer Office. 7755 A

WANTED, CRANE DRAUGHTSMAN for Manchester District. One with first-class general experience. State age, salary, and qualifications.—Address, 7757, The Engineer Office. 7757 A

WANTED, DRAUGHTSMAN, Preferably Accustomed to Detail Work on Machine Tools.—Apply, with full particulars, to ALFRED HERBERT, Ltd., Coventry. 7791 A

WANTED, JUNIOR DRAUGHTSMAN, Accustomed to Detail Work, quick and accurate, for Engineering Works near London.—Address, stating qualifications and salary required, 7790, The Engineer Office. 7790 A

WANTED, LIFT DRAUGHTSMAN by Firm in the Midlands.—Address, stating age, experience, and wages required, 7645, The Engineer Office. 7645 A

CAPABLE DRAUGHTSMAN REQUIRED, with knowledge of Brewery and Refrigerating Work.—Address, with full particulars and salary required, 7792, The Engineer Office. 7792 A

DRAUGHTSMAN, Competent, WANTED AT ONCE in the office of a Consulting Engineer. Must be experienced in Steel-framed Buildings and neat worker.—WHITAKER, 77a, Queen Victoria-street, E.C. 4. Telephone, City 1647. P4188 A

DRAUGHTSMEN (LOCOMOTIVE).—WANTED, ONE or TWO thoroughly qualified DRAUGHTSMEN; also a few good JUNIOR DRAUGHTSMEN, with at least two years' experience after completion of apprenticeship.—Apply, giving full particulars and wages desired, to NORTH BRITISH LOCOMOTIVE COMPANY, Ltd., 110, Flemington-street, Glasgow, N. P4182 A

DRAUGHTSMAN, Mechanical Electrical, for Midland Works, Senior, over 28 years of age. Must have good experience of Electric Traction Motors.—Address, stating age, experience, and salary required, 7699, The Engineer Office. 7699 A

DRAUGHTSMAN REQUIRED, to Lay Out Production Drawings in Works employing about 700 hands, making very accurate machinery. Progressive position for a young man with plenty of energy. Only those who have had workshop experience will be considered.—Address, stating age, experience, and salary required, 7694, The Engineer Office. 7694 A

DRAUGHTSMEN REQUIRED; Two First-class men for provinces, experienced in Steel Work, Materials and Goods Handling Plants and General Engineering. State salary and when at liberty.—Address, 7773, The Engineer Office. 7773 A

DRAUGHTSMAN WANTED AT ONCE for London. Good Structural and Mechanical Engineering experience essential, making own tracings, quick and neat on structural work. Applicants should state age, experience, wages required, and when at liberty.—Address, P4167, The Engineer Office. P4167 A

DRAUGHTSMAN WANTED for Special Machine Tools. Applications only invited from men of first-class ability.—Address, stating experience, 7775, The Engineer Office. 7775 A

DRAUGHTSMAN, with First-class Experience of Steam Turbine design and detail work, for works in Midlands. State age, salary, experience, and when able to commence.—Address, 7658, The Engineer Office. 7658 A

EXPERIENCED DRAUGHTSMEN REQUIRED for Aircraft Works. Sound engineering training essential, but not necessarily on aircraft work.—Reply, stating age and salary, to BOULTON and PAUL, Ltd., Norwich. 7749 A

EXPERIENCED MECHANICAL DRAUGHTSMAN REQUIRED for London.—Address, stating age, experience, and salary required, 7774, The Engineer Office. 7774 A

JUNIOR DRAUGHTSMAN REQUIRED, Capable of Preparing Neat, Accurate Drawings from Models or Sketches. Age, salary, and experience.—Address, P4159, The Engineer Office. P4159 A

MARINE OIL ENGINE INSTALLATION DRAUGHTSMAN REQUIRED. Essential calculate propellers, speeds, power, and conversant Lloyd's rules, pipe work, &c., to 1000 B.H.P. Engine Design experience desirable. State experience, salary, age, and when available.—PETTERS (IPSWICH), Limited, Ipswich. 7771 A

REQUIRED, SIX First-class AERONAUTICAL DRAUGHTSMEN, with good experience of mechanical detail design; preference given to men with sound technical training.—Reply, giving full particulars age, experience, and salary required, to BLACKBURN AERO. and MOTOR CO., Ltd., Brough, E. Yorks. 7752 A

STRUCTURAL ENGINEERING DRAUGHTSMEN REQUIRED in a London office for the Design of Steel-framed Buildings and other Structural Steel Work. A knowledge of reinforced concrete design will be considered an advantage. Furnish age, particulars of training and experience, and salary required.—Address, 7782, The Engineer Office. 7782 A

STRUCTURAL DRAUGHTSMEN REQUIRED for London Works. Must be good detailers, used to Steel-framed Buildings and Roof Work.—Write age, experience, and salary required, Box 652, Dorland's, 14, Regent-street, S.W.1. P4186 A

SITUATIONS OPEN (continued)

A FIRST-CLASS FOREMAN is REQUIRED for the Structural Department of Large Crane Works in the North of England. Only those who have had good experience in the making of Carriages, Girders and Constructional Work for Cranes need apply. Permanent position for suitable man. Replies, which will be treated in confidence, should give full particulars of experience, age, and wages required.—Address, 7786, The Engineer Office. 7786 A

FOREMAN REQUIRED to Take Charge of Power Plant at London Mills.
Plant comprises: National Gas Engines, Mond Gas Producer Plant, Electric Generators, Motors, &c.
Applicants should state experience, age and wages required, &c., in confidence to—
"F" Dept.,
J. and H. ROBINSON, Ltd.,
Deptford Bridge Mills, Greenwich. P4179 A

SITUATIONS WANTED

A CAPABLE ENGINEER, Having 10 Years' Technical, practical, and commercial sales experience with steam turbo-alternator sets and power station practice, DESIRES APPOINTMENT as SALES ENGINEER in Great Britain or Ireland. Public school and college education.—Address, P4172, The Engineer Office. P4172 B

CIVIL ENGINEER (32), A.M. Inst. C.E., A.M.I. Struct. E., DESIRES APPOINTMENT; broad training university and consultant's office; experience mainly bridge and structural work.—Address, P4183, The Engineer Office. P4183 B

COMPANY SECRETARY, CASHIER or MANAGER. Progressive POST DESIRED, Midlands, by man of experience, initiative and integrity. Age 35. Salary required £350. Take full responsibility or assist chief.—BM/ZMLF, London, W.C. 1. P4169 B

CONSTRUCTIONAL STEEL ERECTOR REQUIRES POSITION, home or abroad; experienced in all descriptions of buildings, bridges, &c.; take full charge. Speaks Hindustani.—BROWN, 21, Laburnum-road, Liverpool. P4157 B

ELECTRICAL ENGINEER, A.M.I.E.E., Shortly free, DESIRES POSITION in Purchasing Dept. of Export House, London or provinces. Advertiser fully acquainted export business, all kinds electrical machinery and plant.—Address, P4166, The Engineer Office. P4166 B

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Coal Distillation in Belgium.

THE colliery industry in Belgium has entered upon a crisis of so serious a nature that it has been found necessary to adopt drastic measures in order to save coal mining from a probable collapse. The conditions of mining in Belgium are generally unfavourable to economical production, and the coalowners affirm that they are unable to meet foreign competition with their high costs and heavy transport charges, while foreign consumers will not give preference to a fuel which is inferior to that mined in Great Britain and Germany. In the past, Belgian coal found markets because extremely low wages and railway freights allowed of its being sold at favourable prices, but these circumstances have now changed because wages and transport charges have been brought into line with those in other countries, and because the continental over-production has closed markets that formerly took Belgian coal. Coalowners believe that the industry can now only be saved by carbonising the fuel at the collieries and obtaining by-products for which there is always a ready sale. The coke oven owners in the Charleroi and Mons districts have, therefore, decided to form a company with a capital of something like 300 million francs, the object of which is to erect in each of those districts important works for the carbonisation of coal and the extraction of by-products. The production of hydrogen and of sulphate of ammonia from coke oven gases will also be undertaken. The sale of all the products will be entrusted to one syndicate. Another company will also be formed in the northern districts. When these schemes are carried out the coalfields in Belgium will, it is anticipated, become the centre of a vast chemical industry.

Electrical Research.

SPEAKING at the annual luncheon of the British Electrical and Allied Research Association, held at the Hotel Cecil on Friday of last week, February 10th, Sir John Snell appealed to manufacturers and others for increased financial support. Great organisations for research purposes in America, Germany, and other countries, he said, had been encouraged by vast sums of money, found each year by the large manufacturers, and it was essential that greater financial assistance should be given in this country. While it was desirable that British electrical manufacturers and cable makers should have their own research laboratories, there was a kind of research that could only be accomplished quickly and economically by collaborated and co-ordinated effort. The Association enabled the skilled officers of the electrical manufacturers and cable makers, and the users and purchasers of various classes of machinery, to come together and to discuss their difficulties, to indicate the kind of research that was necessary and to concentrate upon it the combined efforts of their brains. The electricity supply undertakers only contributed about £3000 a year to the Association, a sum which was wholly disproportionate to the benefits conferred by the Association on the industry. Some of the railway companies also owed financial assistance to the organisation. For some generations the country would be faced with a great burden of debt arising out of the war, and it would only be possible for Great Britain to hold her place in the van of the industrial nations of the world by the grit and inherent craftsmanship of her people, by skilful engineering and commercial organisation and by systematised and organised research into the strength of materials and the mysteries of nature.

Admiralty Contracts Awarded.

CONTRACTS have now been awarded by the Admiralty for the six new submarines of the 1927 programme. Vickers-Armstrong, Ltd., of Barrow, have secured four boats—"Perseus," "Poseidon," "Proteus," "Python"—while Cammell Laird and Co. Birkenhead, will build the fifth boat—"Phœnix." The sixth—"Parthian"—is to be constructed at Chatham Dockyard. The five contracts which thus go to private industry are believed to represent a total value of not less than £2,500,000. As their names denote, the submarines belong to the new "P" class, and have been designed for overseas patrol service. The "O" class, which preceded them, comprises nine units. Of these, the "Oberon" has been in commission for some months, the Australian boats "Oxley" and "Otway" sailed recently for Sydney, and six more boats are still under construction, three by Vickers-Armstrong, two by Beardmore, and one at Chatham. The "P" submarines, it is understood, will not be considerably larger than the "O" boats, which have a standard surface displacement of 1346 tons. It is also announced that the single cruiser to be built in the present financial year will be named "Exeter." She belongs to the "B" type, of 8400 tons, and will be laid down at Devonport next month. Contracts are still outstanding for the flotilla leader and the eight destroyers authorised for this year. The leader is to be known as the "Codrington," and the following names have been chosen for the destroyers: "Acasta," "Achates," "Acheron," "Active," "Antelope," "Antony," "Ardent," and "Arrow." They are expected to resemble the "Amazon," which has a displacement of 1330 tons and a designed speed of 37 knots. The "Codrington" will be the first flotilla leader to be laid down for the British Navy since the war.

French Naval Developments.

THE French naval authorities are extremely gratified by the trials of the new cruiser "Tourville." This 10,000-ton vessel, which was built at Lorient Dockyard and engined partly by the Ateliers et Chantiers de Bretagne and partly by the State factory at Indret, was launched in August, 1926. She has Rateau geared turbines of 130,000 S.H.P., taking steam from nine Guyot boilers, the contract speed being 34 knots. On her preliminary runs she attained a mean speed of 34·13 knots, with an output of only 105,000 S.H.P. Although the ship was in light condition at the time, her main armament not being on board, it is anticipated that at full load she will be able to reach her designed speed with ease. The success of these trials is a further tribute to the type of boiler which has been adopted by the French Navy since the war, and which had already given excellent results in the three 8000-ton cruisers of the "Duguay-Trouin" class. Details have now been released of the submarine "Redoutable," which is to be launched at Cherbourg on February 24th, after being over two and a-half years on the stocks. She was designed in the first instance as a submersible cruiser, but the plans apparently were modified, and she is now rated as a *sous-marin de grande patrouille*. The design is considered to be so satisfactory that twenty-nine similar vessels are now under construction or projected. The "Redoutable" is 92 m. in length, 8·16 m. in breadth, and displaces 1560 tons on the surface and 2080 tons when submerged. Diesel engines of 6000 B.H.P. are installed, the contract surface speed being 18·5 knots. The equipment is reported to include a small folding seaplane.

Research Associations.

THE annual report of the Committee of the Privy Council for Scientific and Industrial Research, which has just been issued, contains a list which shows that there are now in existence in this country twenty-four research associations. The vitality of some of these associations would, however, appear to be doubtful. One at least, the Iron Manufacturers, has been in a state of suspended animation since 1925, while to two of them the department has ceased to pay grants. Two more are operating without financial assistance from the Department. It cannot, however, be doubted that among the other associations there is a great amount of healthy activity. The British Scientific Instrument Research Association, for example, has been in existence for nine years and during that time has received from the Department grants totalling over £84,000. The British Cotton Industry Research Association has been at work for eight years and has received within a few hundred pounds of the same figure. The size of the grants made is of significance because, speaking broadly, it is determined by the amount contributed by the industry itself on a pound for pound basis. The Research Associations for the Woollen and Worsted and the Linen industries are also doing well, having been in existence eight and seven years, and having received respectively £45,000 and £50,000 by way of grants. Among the associations whose work has a bearing on engineering, mention should be made of the Non-ferrous Metals Research Association, which in seven years has received £34,000, the Electrical and Allied Industries Association, which has received £58,000 in six years, and the Cast Iron Research Association, which in six years has received £17,000.

The Engineer-in-Chief of the Fleet.

IT is announced by the Lords of the Admiralty that Engineer-Rear-Admiral Reginald W. Skelton, C.B., D.S.O., C.B.E., has been appointed to succeed Vice-Admiral Sir Robert B. Dixon, K.B.E., as the Engineer-in-Chief of the Fleet from June 1st next. Admiral Skelton received his education at Bromsgrove School and the Royal Naval Engineering College at Devonport, which he left in 1894 to join H.M.S. "Centurion" in the China Squadron. After subsequent service in H.M.S. "Majestic" in the Channel Squadron, he was appointed in 1900 to superintend the building of the "Discovery" for the National Antarctic Expedition, in which he served as chief engineer, under the late Captain R. F. Scott. After some submarine service he was appointed to H.M.S. "Superb" and later to H.M.S. "Agincourt" as Engineer-Commander. Following a further year on submarine service, he went as Engineer Officer to Archangel, and in 1922 and 1923 served as Fleet Engineer Officer with the Mediterranean and Atlantic Squadrons. He was made Engineer-Rear-Admiral in 1923, since which time he has been chiefly engaged in technical and administrative duties at Portsmouth and the Admiralty. Another interesting recent announcement relates to the late Director of Naval Construction at the Admiralty, Sir Eustace Tennyson d'Eyncourt. Sir Eustace has resigned from the board of Sir W. G. Armstrong, Whitworth and Co., Ltd., and has started practice as a consulting naval architect and marine engineer in Westminster. We understand that Sir Eustace will continue to act as a special consultant to Vickers-Armstrongs, Ltd., and that he will remain a director of the Parsons Marine Steam Turbine Company, Ltd.

Motor Vessel Conversion Costs.

WE have referred at various times to the extensive programme for the conversion of laid-up steamers to motor vessels which is being carried out by the United States Shipping Board. Eleven ships have already been converted and quite recently some official figures regarding the cost of converting the vessels were made known. The total expenditure proposed is close upon £5,000,000, of which £1,788,618 has already been spent. This amount is apportioned as follows:—"Tampa," £148,100; "Unicoi," £149,800; "West Honaker," £160,314; "West Grama," £165,000; "West Cusetta," £162,314; "Crown City," £162,314; "Sawokla," £163,920; "City of Rayville," £163,920; "City of Dalhart," £165,950; "Yomachichi," £173,830; "Seminole," £173,156. Typical details of the way in which the sums mentioned have been spent have been given for the vessel "City of Rayville." On this particular ship the installation costs were £45,430, while special alterations represented £26,960. The cost of the main engine and spare parts is given as £49,460, added to which there were other items, as follows:—Deck machinery, £5860; hull repairs, £7100; equipment and outfit, £5000; expenses, £7600; and engine-room auxiliaries, £18,800. We understand that the total cost of the propelling engines and auxiliaries has not exceeded about £700,000 for the whole eleven ships, so that over £1,000,000 has been required to refit, repair and render the hulls ready for their new engine equipment. It has been pointed out that most of these ships are from seven to ten years old, and as they have been laid up for some time, they do not bear economical comparison with the new motor cargo vessels which are now being constructed in this country for speeds of between 14 and 15 knots, or 3 to 4 knots faster than most of the converted vessels.

Transatlantic Airships.

ACCORDING to a message received from New York, Commander C. D. Burney, M.P., of the Airship Guarantee Company, has intimated that an American undertaking is being formed to build airships in the United States and to operate them under the American flag on the Transatlantic route in co-operation with a similar number of airships built in this country by Commander Burney's firm for service on the same route under the British flag. The arrangement is apparently to become effective on the completion of successful trials of the airship R 100 now being built at Howden by the Guarantee Company. That airship is expected to be completed in time to enable her to undertake a demonstration flight across the Atlantic next September. Having carried out that flight she is to be used on the England-Egypt air route. Meanwhile, the Zeppelin passenger airship L127 would appear to be rapidly approaching completion in Germany, although it is doubtful whether she will be finished this month as was at one time indicated. This vessel is to be employed on a transatlantic service between Spain and Argentina.

Television.

A TELEVISION experiment recently carried out by Mr. T. L. Baird, between this country and America, is said to have proved successful. The transmitted images of "sitters" in London were received at Hartsdale, a village outside New York, and although the images were crude and broken, the results came up to expectations. Movements made by the "sitters" in London could be observed in America. Considering the low power of the transmitter and the simplicity of the receiving apparatus, Mr. Baird is satisfied with the performance, and considers that, with more power the results might easily be improved. Whilst the studio is in London the transmitting station is at Purley, and a land line between these two places formed the first link in the route, the remainder of the distance being covered by wireless. The images were transmitted on a wave length of 45 m. Owners of wireless receivers can pick up television transmissions in the form of sound, which is different for every kind of object. Movement of objects cause changes in the sound, so that a man can be heard turning his head or opening his mouth. Mr. Baird has also been engaged for some time past upon the development of an invisible searchlight, and arrangements are being made for the installation of his apparatus on one of New York's skyscrapers for the purpose of showing how the invisible ray can be used to detect aeroplanes.

Gisborne Harbour Works, New Zealand.

GISBORNE is a seaport town on the East Coast of the North Island, New Zealand, being situated at the north side of Poverty Bay. The district, which is one of the most prosperous and wealthy in the Dominion, exports large quantities of wool and frozen meat and produce each year. It has, however, experienced much trouble from the fact that its harbour is subject to silting. There was a time when the Turanganui River, on which the town stands, was navigable at all times for vessels of 1000 tons displacement and over. Passengers travelling North to Tokomaru Bay and Auckland, or South to Napier, were able in those now far-off days to walk straight on to the steamer on which they were to travel, and were saved all the difficulties and inconveniences that are attendant on the necessity to proceed by tender to steamers in a roadstead.

For some years prior to 1910 attention had been directed to proposals to erect harbour works outside the confines of the river, in some cases miles distant from Gisborne. Suggestions as to the position of the harbour varied from under the lee of Young Nick's Head, which is on the opposite side of Poverty Bay to which Gisborne itself is situated, to various sites along the foreshore of the suburb of Kaiti. Although an outer harbour for big shipping was being considered, however, most of the residents in the district were more or less content with the river harbour, which was handling small shipping in quite a satisfactory way, but the Board had always had difficulty in keeping the harbour clear of silt.

The Tauranganui River splits right in the centre of the town into two rivers, the Waimata River to the North and the Taruheru River to the West. The Waimata River creates most of the trouble, and, during the rainy season, it brings down vast quantities of silt, which remain in suspension until it reaches the sea, the tide then backing up the waters of the river and causing the silt to be deposited. Frequently, the river would be quite free for navigation on one day, but during the night it would rain heavily, with the consequence that the following morning the river harbour was unusable by anything but vessels of the shallowest draught. The Waimata River runs through a steep valley on its journey to the sea, and it is from the hillsides of that valley that the trouble starts.

To overcome the menace of continual silting, the Harbour Board decided to carry out certain works, and, in addition, to purchase a dredger to remove the silt. On the Kaiti side of the river—that is, opposite the town itself—there was at one time a wide pool, which at certain stages of high tide could be used by vessels when swinging, and the Board decided to build a wall across and fill it in behind it with a sand pump, with the idea that the narrower river would bring about a scour in times of flood. Other works were carried out with the same idea, but none of the schemes came up to expectations, and gradually the harbour went from bad to worse, until nothing but shallow-draught vessels of the scow type were able to navigate the river, even at high water. Naturally, such conditions considerably hampered the trade of the port, and though export and import returns did not fall, handling charges were considerably increased.

The continual silting of the river drew the attention of residents to the inner harbour, and there was a growing opinion that any scheme for future harbour improvements should embody the works already carried out in the Turanganui River. Breakwaters and groynes had been in existence for a number of years, and it was thought that if the "range" created in the river by the heavy seas outside could be overcome, then the silt-bearing waters of the river would have a freer outlet to the sea, and all would be well. With that idea in view, the Board decided to place an extension on the breakwater, and the work was duly carried out, but, like all other works in this connection, it failed to fulfil expectations.

Out of all these tribulations, however, came some organised idea of improvement, and the wide circle of opinion has narrowed down to something less vague than had been the case during a period of nearly fifty years. The Board wanted a good harbour that could be used at all tides, but it did not want that harbour to be "anywhere"; it had to be at the front door of the town, so to speak, and, finally, it was decided to adopt the proposals of Mr. Leslie H. Reynolds, an engineer who had made a study of the conditions over a period of years.

Most of Gisborne's troubles have, as has been said, emanated from the continual silting up of the Turanganui River, and Mr. Reynolds' scheme, which is now being carried out, embodies the deviation of that waterway, so that its silt-laden waters will be discharged outside the harbour. When it is completed the waters from the Waimata Valley will be carried past the harbour itself, and that portion of the river that is to be used to accommodate shipping will become an arm of the sea, and entirely free from the deleterious effects of the waters from inland. As a result of the present operations, it is expected that the harbour will at once be able to accommodate vessels, 200ft. in length with a 14ft. draught, having a capacity of 800 tons, and with subsequent dredging operations, which are expected to take about a year, the harbour should, it is anticipated, provide for vessels 300ft. in length, with a draught of 21ft., and a capacity of 3000 tons. What is aimed at, at the moment, is the creation of an all-tide harbour which would allow produce, coal, and fair-sized passenger boats to lie alongside the wharves close to the town, but under the present proposals wool and mutton boats will still have to be lightered, as is the case at present. The lighters, however, will be able to work the port at any phase of the tide.

The adopted scheme, now being given effect to, provides for:—

(1) The diversion of the river to the Westward;
(2) The construction of breakwaters for the purpose of eliminating "range" within the harbour; and
(3) The construction of wharves, slipway, railway and other facilities.

The estimated cost of the present works is £900,000. Operations were begun over two years ago, and the following are some of the salient points with regard to the work and the plant used in connection therewith. In Fig. 2, page 184, is given a view of the town showing the river Waimata before the diversion work was begun.

The diversion of the river is being effected by a dredger, specially purchased for the purpose from the Australian Government, which is a self-propelling, bow well bucket dredger, with a capacity of 900 tons per hour. She has proved a most effective machine for dealing with the work of cutting out the river diversion. Working in conjunction with three steel hopper barges of a capacity of 500 tons each, she steadily cuts her way to the sea through hard "*papa*" rock, clay, sand, silt, &c., sometimes dredging more than 3000 tons during a day, and, at the time of writing, she had reached practically high water mark on the Waikanae Beach, where the cut is to debouch on to the sea. Views of this operation at different stages are given in Figs. 3 and 4, while Fig. 5 shows the upper or land end of the diversion cut, in which a part of the training wall is seen under construction.

The training and diversion walls at the side of the cut are constructed of reinforced concrete piling of special design, the training wall down the centre of the river consisting of two rows of T-shaped piles, cut off at 2ft. above low water and finished on the diversion side with flat slab construction to 12ft. above low water, supported at the back by trestle frames. The whole of this reinforced concrete construction, as far as practicable, is of pre-cast formation, and is tied together in one composite whole by means of *in situ* work. This training wall has been designed to be capable of carrying a wharf at such date as it may be required. The diversion walls at the side of the river are also of T-shape design, being tied back at intervals to reinforced concrete anchorages. One part of the diversion wall adjoins the railway and had to be specially designed accordingly. The carrying out of this section entailed, at periods, working day and night so as to reduce the interruption of railway services to a minimum.

The manufacture of the pre-cast reinforced concrete members for the various sections of work is being effected in a specially laid-out construction yard, which has been so designed as to reduce manual labour as far as practicable. The handling of the material from its arrival at the yard to its removal is mainly mechanical, the process being briefly as follows:—The shingle and sand—from Napier and Waikokopu respectively—are brought in ships alongside the wharf and the material hoisted from the ships' holds by a grab operated by steam crane, shot into hoppers, and hoisted up an incline where it is discharged into its respective bunkers. Under these bunkers is a tunnel, and the shingle, sand and cement are admitted into skips through self-measuring hoppers, automatically controlled, then hoisted up an incline to the concrete mixer, from which the mixed material is transported by means of light travelling gantries to the various moulds. Approximately 8000 pieces have to be cast in this yard from some forty patterns, varying in size and shape, and of weights ranging from a few hundredweights to 4 tons each.

The piles for the walls were driven by two steam hammers mounted on individual frames, with boilers separately mounted, each unit travelling on its own carriage. The whole plant is operated from a temporary staging, consisting of Oregon stringers on blue-gum piles, this temporary stage being picked up as the work proceeds and re-used for the same purpose further on the line of walling.

It is proposed to construct the breakwaters of concrete blocks on a stone mound base. Exhaustive investigations were made over a long period before stone of a suitable nature, and sufficiently near to Gisborne to be handled and transported economically, was discovered. The quarry, which was eventually decided upon, and which is now being worked, is at Whareongaonga, on the coast, some 12 miles South of Gisborne, and the freehold of it has been secured by the Board. Professor Speight, of Canterbury College, has examined and reported favourably upon this stone, and quarrying is now proceeding. As the stone will have to be transported by water to Gisborne, it was essential that a shelter for the craft should be provided near the quarry, and that is being done by the construction of a protective breakwater, consisting of a mound formed of quarry stone and terminating with the hulk of the old U.S.S. steamer Monowai, which is shortly to be placed in position. This hulk will give shelter from the north-easterly winds—the bay is protected from all other winds—and it will at the same time afford berthage for the transporting craft.

At the quarry face the stone is handled by a Ruston steam navvy on caterpillar treads, and a 20-ton and an 8-ton steam locomotive crane handle the stone. The stone is then conveyed in skips or trucks to the loading berthage, from whence it is handled by a 20-ton derrick crane on to the decks of the two transportation self-propelling scows. These scows are fitted up with tipping gear, so that upon arrival at the site of the breakwater construction it will be possible in a simple manner to deposit the stone where and as required. When sufficient stone is deposited to the requisite height—mainly 12ft. below low water—to form the base of the breakwater, divers will be engaged in levelling this base in preparation for the concrete blocks, the manufacture of which is in hand at the block yard at Gisborne.

This block yard, like the construction yard previously referred to, has been designed to eliminate manual labour as far as practicable. The shingle and stone from the adjoining beach and the stone from the quarry are hauled by electric power up inclines and dumped over tunnels, through which they are conveyed to a central tower, thence being elevated—the stone first being crushed to the required size by a jaw stone crusher—by bucket elevators to the top of the tower and passed through screening plant and into the respective bins, with a total capacity of 700 tons, whence they are automatically conveyed to the mixer. The concrete from the mixer is discharged on to a scraper conveyor working through a 100ft. light lattice horizontal girder having a swing over a semi-circle, and, by means of gate valves at intervals, the concrete can be deposited into the moulds at any required position, rubble "plums" being added simultaneously. When sufficiently set, the concrete blocks, weighing 20 tons each, are lifted by a Goliath crane and deposited in the seasoning yard till required. When that time arrives, the blocks are lifted by the crane and placed on the railway trucks, if for the construction of the extension of the existing breakwater, or on a scow if needed for the construction of the outer breakwater. This crane is steam operated, but the remainder of the block yard

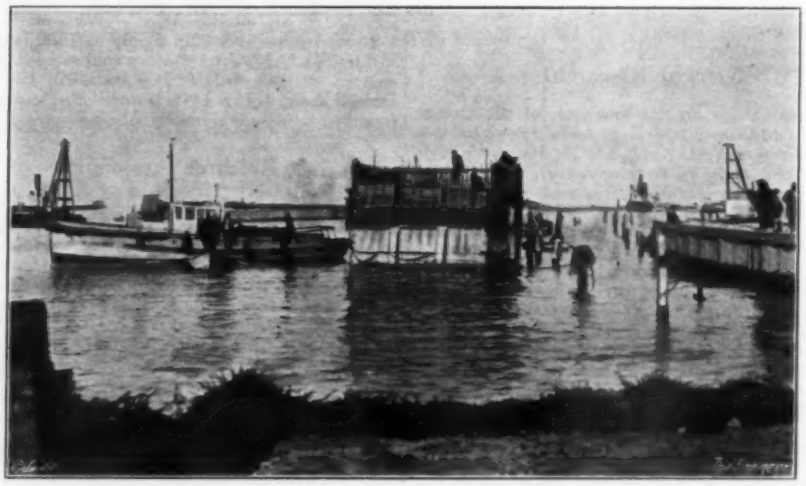


FIG. 1—CONCRETE CAISSON FOR BREAKWATER CONSTRUCTION

plant is electrically operated, power being supplied by the Poverty Bay Power Board.

As a starting base for the commencement of operations for the extension of the existing breakwater, a reinforced concrete caisson was constructed. Its launch is seen in Fig. 1. It was to be floated to its position at the end of the existing breakwater, and sunk into place on to a specially prepared base. Upon this caisson will be erected a crane weighing 112 tons, which has a reach of 60ft., and will pick up the concrete blocks and place them in position, this work being assisted by divers. The crane will then advance upon the breakwater so constructed, and the work will thus proceed.

The provision of berthages in the shape of new and additional wharves is well provided for, and already 1000ft. of wharf have been constructed, the material employed being timber, but other wharves will be of concrete. This wharf was constructed with a Tasmanian stringybark superstructure upon Australian turpentine piles, and, before the piles could be driven, the "*papa*" rock had to be drilled to take them, the average drilling throughout being approximately 14ft. The rock drilling and pile-driving operations were carried out from a travelling gantry which advanced as the work progressed, and which was so designed as to expedite the work as much as possible, the time occupied in shifting the staging from one pile to another being a matter of but a few minutes. A small crane was carried on the back of this stage, and was used for handling all the timber, &c., so as to relieve the carpenters of the actual labour of fixing the superstructure.

Reinforced concrete piles are now being made for the 1000ft. extension of the wharf, this wharf being so designed that the greater part of the members, including piles, beams, &c., will be pre-cast in the yard so as to ensure good work and to reduce the "in situ" concrete work to a minimum, as experience has shown that adherence to that practice ensures expedition and effects economy.

A new slipway, which may be seen under construction in Fig. 2, has recently been completed. It is now in commission, and is proving a most valuable adjunct to the Board's plant. This slipway is of concrete construction throughout. The outer and lower portion was built within a cofferdam, 150ft. long, the work being carried out at a depth of 20ft. below water. This cofferdam was constructed of Oregon sheet piling, with hardwood tongues, and owing to the nature of the bottom into which these piles were driven—the lie of the "*papa*" causing the pile toes to shoot in various directions—it was found necessary to cut a chase in the rock into which to drive the piles. The dam, when completed, proved very satisfactory, working conditions being attained with but little pumping. From within the cofferdam, the "*papa*" and clay were excavated by means of pneumatic spades to the required depths and the floor finished and rails laid to the necessary gradient.

The ways to the upper half of the slipway are constructed on reinforced concrete piling, and the whole of the floor to that portion is paved with concrete. The walls are of similar construction to the diversion walls previously referred to, and, despite the many difficulties met with in the driving of the piles, owing to material through which they had to be driven being mainly made-up ground, with timber, logs and other obstructions, the work was brought to a successful completion.

Scientific and Industrial Research.

THE annual report for the year 1926–27 of the Committee of the Privy Council for Scientific and Industrial Research was published at the end of last week. As usual, the Committee's report to his Majesty the King is accompanied by a report to the Committee from its Advisory Council. From the Advisory Council's report we take the following passages.

Maintenance Allowances to Students.—We have satisfied ourselves that the students who receive allowances are of the right type and find the kind of employment for which they are trained. Our inquiries show that the number of cases in which a student's work does not justify the award made to him is negligible.

We have examined the careers of those who held maintenance allowances before 1926 and, dismissing those cases in which no information could be obtained, we found that 34 per cent. are engaged in industry, 22 per cent. occupy Government appointments, 18 per cent. hold university posts, 9 per cent. are continuing research while holding scholarships, and the remaining 17 per cent. are employed in miscellaneous ways. These proportions naturally vary in different subjects; for example, in engineering the majority of students enter industry, while the universities secure for teaching posts most of the few students of physics.

We drew attention last year to the large number of grants given to students of chemistry, and stated our view that too many men are encouraged to specialise in this subject. We find, however, that one-third of the students of chemistry who received grants from the Department are now employed in research in industry, and another third in research in Government laboratories and universities. These results are satisfactory in two ways; they give welcome evidence of the steady expansion of chemical research in industry, and they show that the demand for first-class students of chemistry does not fall short of the supply.

We regard the situation disclosed by our statistical inquiry as satisfactory; the allowances have clearly fulfilled the purpose for which they were originally instituted, namely, that of supplying fully trained men to meet the special needs of the years immediately after the war.

Grants to Research Workers.—These grants fall into quite a different category from the maintenance grants to students; their main object is not to produce scientists, but scientific results. The award of such grants should be regarded, within limits, as a permanent function of the Department.

During the year grants have been renewed to the Cavendish Laboratory in aid of investigations on intense magnetic fields, and to the Royal Institution for work on X-rays and crystal structure. It is of interest to note that the use of X-rays in metallurgical and other researches is steadily increasing. The instruments and method developed by Sir William Bragg and his collaborators at the Davy Faraday Laboratory of the Royal Institution are known and used in many countries, to the advantage not only of science and industry in general, but of the British scientific instrument industry in particular. Practically all the investigators who were originally appointed to work under Sir William Bragg as the result of the grants made by the Department are now developing X-ray methods in other research institutions.

We have recently recommended a grant of approximately £1500 a year for three years to enable the Imperial College to appoint research assistants to Professor Bone for work on chemical reactions at high pressures. Imperial Chemical Industries, Ltd., is supplying the College with the expensive equipment necessary. The use of very high pressures in chemical manufacture is rapidly extending, and it is important, in our opinion, to encourage at least one university centre to organise scientific research in directions which promise such great industrial advances. Work of this type is not without danger, and requires the supervision of a highly skilled staff.

Geological Survey and Museum of Practical Geology.—The state of the Geological Survey Offices and Museum in Jermyn-street continues to cause us anxiety. We venture to hope that in spite of the urgent need for national economy, which we fully realise, it will be possible to proceed shortly with the scheme sanctioned in 1925. We feel sure that the expenditure involved is necessary in the interests of the community, and that it is most uneconomical to continue to spend money in an endeavour to keep in habitable repair an old building which experience has shown to be wholly unsuited to its present purpose.

Geophysical Methods of Survey.—During the last few years considerable attention has been directed to the possibility of detecting underground mineral deposits by means of geophysical methods. These methods include the determination of local variations of the value of gravitational force, the electrical conductivity of the earth, the magnetic field, and other phenomena which are known to vary, though often to a very minute extent, according to the nature of the substrata. Most of the practical work hitherto has been carried out on behalf of private interests, and there is little reliable public information available. We have taken a first step, at the suggestion of the Director of the Geological Survey, by recommending that a thorough scientific test of the gravitational methods should be undertaken in a suitable district in England, the geological formation of which is known with accuracy.

Two officers of the Geological Survey and Museum carried out a test with the Eötvös torsion balance over the concealed portion of the Swynnerton Dyke, Staffordshire, in July and August, 1927. The traverse was approximately 100 yards long and observations were made at twenty stations. The qualitative results obtained were extremely satisfactory, the curve of the values of the gradients disclosing the presence of a dyke dipping steeply towards the west, in the position where it had been previously mapped. Quantitative interpretation of the results, *e.g.*, the width of the dyke, its angle of dip, and its depth below the surface, is in progress, but will take some time owing to the complicated nature of the calculations involved.

National Physical Laboratory.—During the year we received a report from the Executive Committee on the general needs of the Laboratory for building and major equipment. The most important project the Committee has in view is the provision of a suitable physics building. Plans for a new physics building were prepared in 1924, when we recommended that a start should be made by building a central block sufficient to accommodate all the work now carried out in Bushy House. This would have had the special advantage of removing investigations from a place where experimental work entails risks of fire which are by no means inconsiderable, and setting free suitable space for storage, which is badly needed, particularly for housing the fundamental standards and apparatus in the charge of the Laboratory. Provision for this work was included in the estimates laid before Parliament in 1925, but, as in the case of the Geological Museum, sanction was subsequently withdrawn. We reconsidered the matter this year, and we recommended that sanction be again sought to proceed with the erection of a suitable building.

Fuel Research.—During the year we were pleased to learn that the Gas Light and Coke Company, after an exhaustive survey of existing plants, had selected the experimental retorts developed at the Fuel Research Station as being the most promising type for the commercial trial of low-temperature carbonising processes for use in conjunction with London gasworks. We welcome the decision of the Government to guarantee a loan to a subsidiary company of the Gas Light and Coke Company to enable it to erect a bank of these retorts capable of producing about 100 tons of smokeless fuel a day. The plant when erected will be worked by the company at its expense under commercial conditions for three years; and all the results will be made freely available to British firms. We consider that this plant should effectively indicate the value and possibilities of low-temperature carbonisation to the gas industry. Many exaggerated claims have been made on behalf of low-temperature carbonisation, and the natural result of unfulfilled prophecies is that in many quarters undue pessimism prevails. We consider that neither extreme optimism nor pessimism is justified, since we have yet to learn the facts on which a sound judgment of the commercial success on a large scale of any low-temperature carbonisation process can be based. The approved scheme will, we hope, provide the essential facts.

Great interest has been aroused recently by accounts of a new process for the conversion of coal into light petroleum products which is now being developed in Germany on the commercial scale. As a result of the arrangement entered into eighteen months ago by the Department with Dr. Bergius and the British Bergius Syndicate, a number of experiments have been carried out at Rheinau, in Germany, on the treatment of selected British coals with hydrogen under high pressure at moderately high temperatures. The experiments, which have been confirmed by other investigations at the Fuel Research Station, have shown beyond doubt that by such treatment a large proportion of the coal substance can be converted into liquid fuels. The information in the possession of the Department does not, however, make it possible to assess the commercial value of these developments, which, we are glad to learn, are being followed up energetically by the British chemical industry. The new process, being in its infancy, has, like every infant, vast possibilities: for the first time we can envisage on the sure basis of experimental results the production from coal of liquid fuel in sufficient quantity to supply all the requirements of motor transport should natural supplies of petroleum fail. Whether this new industry can be established on a large commercial scale before the natural sources are insufficient to supply the increasing demand for liquid fuels, remains to be seen.

Atmospheric Pollution.—Arrangements have been made, on our recommendation, to transfer to the Department the conduct of investigations into atmospheric pollution previously carried out by the Air Ministry Advisory Committee on Atmospheric Pollution, and consisting of (1) routine measurements and analysis of atmospheric pollution, and (2) research on the origin, nature and extent of such pollution. Under the new organisation the work will in future be supervised by a Committee of the Fuel Research Board, known as the Atmospheric Pollution Research Committee.

Building Research.—The new Building Research Station at Watford has now been occupied for eighteen months, and it has been possible for the work to proceed on the expanded scale. There are definite signs that sections of the building industry are ready to co-operate as units with the Station in the investigation of problems affecting their products. Steps are being taken by the Station, by publishing papers and articles and by delivering lectures, to bring the results obtained home to the members of the industry. We hope that these efforts will lead to greater advantage being taken of the facilities offered by the Station, and, what is more, that the industry will seek to absorb the new knowledge and to apply it to practical ends.

Forest Products.—The transfer of the staff of the Forest Products Research Laboratory from the Royal Aircraft Establishment, Farnborough, to the new station at Princes Risborough, took place in June. The new station is by no means complete, but the large testing shop is ready and in use. There is a growing interest among big users of timber in the work of the Forest Products Research Board, and we are confident now that the economic effects of the investigations being undertaken will become rapidly appreciated.

Water Pollution.—The possibility of organising research on the prevention of the pollution of rivers and other sources of water supply by industrial effluents and sewage has been discussed by us for some time. We had the advantage this year of considering a comprehensive joint memorandum on the subject by the Ministry of Health and the Ministry

of Agriculture and Fisheries. As a result a Water Pollution Research Board was set up. The fact that consumers as a whole get their domestic supplies of water so pure and so easily is a great tribute to the value of the work of individuals and public authorities in the past. Indeed, the very excellence of the present water supply tends perhaps to obscure the need for the continuous support and extension of the work now going on under various auspices. Yet we have no doubt that the interests of the community demand that the State should take a direct share in the necessary research. The purification of water supplies is of rapidly growing importance, for, owing largely to the improved standards of sanitation, the domestic consumption of water has been increasing so greatly during this century as to make it by no means improbable that, in the search for additional sources of supply, recourse will have to be had to many rivers which have hitherto been considered quite unsuited for use. We are dealing here with a field of scientific work where co-ordination is essential for real progress as well as for economy of effort, and which will justify continuous study by experts.

It has been estimated by the Ministry of Agriculture and Fisheries that 70 per cent. of the present damage to fisheries is caused by sewage. The purification of sewage is clearly a problem of such importance as to justify the State participating in the necessary scientific research. The modern "activated sludge" or "bio-aeration" process of sewage treatment, although of great promise, is based largely on trial and error, and unforeseen difficulties arise in practice. Prolonged investigations will probably be necessary before the underlying principles of this method of sewage treatment are properly understood. Further, the wet solid residue which remains after the purified sewage effluent is discharged has a proved manurial value, but up to the present it has been found impossible to evolve a cheap method for drying it sufficiently to make it suitable for transport without impairing its manurial value, and the problem will require investigation on the large scale.

The purification of trade effluents presents special difficulties. It is stated that on some rivers fish are directly poisoned by trade effluents and great damage has been done to important salmon fisheries by the pollution of tidal waters, which cuts off breeding salmon from access to the spawning grounds and destroys smolts in their endeavour to reach the sea. Practically every manufacturing industry has its own special difficulties in purifying effluents, and in many cases no satisfactory method has been found which does not add too greatly to the manufacturing costs. In such cases the community has to choose at present between the two evils of destroying the industry and destroying the river as a source of recreation, profit, or domestic water supply. Here again laboratory research is important, but not sufficient; the new Research Board will seek to co-operate with industries in large-scale investigations of the most economical methods of treatment.

One of the most injurious trade effluents, the investigation of which is already receiving the attention of the Board, is produced by the beet sugar industry. Although this industry has been successfully practised abroad for many years, we are informed that no method of satisfactorily purifying its effluents has been evolved which can be applied successfully, and at a sufficiently low cost, under the conditions obtaining in this country. The Board has already made arrangements for investigating, during the 1927–28 manufacturing season, the possibilities of biological treatment of the various types of waste water produced by the industry. Facilities for the work have been afforded at one of the factories and a substantial contribution towards the cost is being made by the industry.

Steel Castings.—From information given to us by the Engineering Departments of the Admiralty and War Office, it appears that the production of sound steel castings leaves much to be desired. The matter is of considerable importance to the Service Departments, as well as to industry in general, and we have recommended that the Engineering Board of the Department should undertake a full investigation of the causes, and methods for prevention of flaws in castings. The Board has arranged for the direct supervision of this work to be entrusted to the Research Department, Woolwich; selected naval dockyards will co-operate in the work, and the National Physical Laboratory will be responsible for an investigation of the effect of gases on the solidification of steel.

Research Associations.—The Research Association of British Motor and Allied Manufacturers continues to receive little support from the now prosperous motor industry. During the past year the Association notified the Department that it was unable to secure from its members in respect of the year beginning April 1st the subscription income of £4200 which was necessary under the conditions recommended by us to make it eligible for grant from the Department. This sum is substantially less than the amount which would be obtained by a voluntary levy of 6d. per motor vehicle produced annually by the industry. We regret that the industry takes this view of its co-operative research organisation, and we see little hope that the Association will be supported on a scale which would make it possible to produce results of first importance to this great industry. Substantial progress will, no doubt, continue to result from the large amount of research work which is now being undertaken by private firms and by research departments of the Fighting Services, but we would have liked to see in addition to, and in co-ordination with that work a central organisation adequately supported by the whole industry. We understand that the comparatively few firms subscribing to the Association intend to preserve the Association in being on a small scale without State assistance.

Our general recommendations continue to be based on the accepted policy of making these trade research associations self-supporting on an adequate scale in all but the most exceptional cases. Our experience has shown that this object will not be attained by any rigid application of conditions of grant in an experimental and novel scheme of this nature. Our recommendations are based on a consideration of the merits of each case, of the state of the industry concerned and of similar work being done elsewhere.

During the year the Department published a pamphlet entitled "Co-operative Industrial Research," which gave an account of the work of research associations under the Government scheme. The pamphlet describes in a comprehensive way the more important results achieved by the research associations.

We were glad to note the general interest taken in this document and the many favourable notices of it which appeared in the Press. There is some indication, however, that a section of the scientific world does not appreciate either the actual or the potential value of the associations and tends to judge them by their capacity to produce striking industrial advances or public scientific discoveries. Now, as we have said before, and as was emphasised by the Lord President in his preface to the pamphlet, our country is not behind others in its purely scientific work; what it lacks is the application of scientific discoveries, and above all of scientific method, to industry. New industries may spring up from individual discoveries and by individual effort; but as a new industry grows or merges into a staple industry it will depend more and more on co-operative effort for its health and progress. In this co-operative effort which is needed to preserve and develop our great industries the scientific man must take his share; he must be concerned with the necessity for improvement in detail no less than with more spectacular endeavours to strike out into new paths. It must be admitted that in the short space of about nine years the Research Associations have made no scientific discovery and no industrial invention of sufficient magnitude to excite the interest of those who can only see a dazzling light; but we have no doubt that they have already produced results of financial values far greater than their whole expenditure, and have been instrumental in introducing scientific methods and encouraging the scientific spirit in industry. The ultimate value to industry of their work cannot be assessed merely in monetary terms.

The Engineering Information Service at the Science Library, South Kensington.

By S. C. BRADFORD, D.Sc.

THE useful scientific and technical literature of the world is accumulating year by year at the rate of some ten thousand separate works and fifteen thousand volumes of periodical publications. As this vast record is beyond the grasp of any individual, a clue is needed to direct the seeker to the particular volumes that contain the information recorded upon a definite subject of inquiry. Could such a clue be provided, 50 per cent. of scientific and engineering research might be dispensed with, or its present useful yield be doubled.

For generations attempts have been made to index and classify information, so as to provide the necessary clue, and to-day the total bibliographical effort has become so great that, were it properly directed, it would probably suffice to index nearly the total output of scientific and technical literature. Unfortunately, however, published bibliographies are of restricted utility, for the reason that bibliographical work is undertaken everywhere, at home and abroad, without attention to the canons of bibliographical science, or previous experience of its methods. Abstracting or indexing agencies adopt different systems of classification and forms of publication, so that it is impossible to amalgamate their work into a single series, and the information collected becomes hopelessly lost again in thousands of separate volumes and parts. Every bureau indexes or abstracts papers that are done also by other bureaux, and only a portion of the literature is covered. It has been found that even monthly summaries or abstracts of current literature do not meet the case, because, what is needed is, not a guide to all the information of the moment, but an index to all the papers that relate to a particular subject of study, no matter when they were written. The present disorder is the economic necessity of this uncoordinated individual action.

However, the simple clue by which the labyrinth can be threaded is to hand. Although it is beyond the power of a single Institution to provide an index to the scientific and technical literature of the world, yet if all bibliographical undertakings could agree to use the same system of classification, all published bibliographical work could be brought together into one repertory, and the problem of a universal bibliography would be solved. In such a master classification, a place must be provided for every subject of study, however special, and provision made for new discoveries and inventions. It would be necessary that the scheme for each special subject should be drawn up by an expert and afterwards submitted for criticism individually to several experts, before being adopted.

It so happens that one such system of classification, and only one, is available. This is the Brussels extension of the Dewey Decimal Classification. This classification has been applied to the indexing of every kind of literature on all branches of human knowledge, and has stood the test of practical use for twenty-five years or more. The system has been used by numerous bibliographical undertakings, and the amount of material that has been classified by the scheme is very considerable. Practically all of this material that relates to science and technology has now been collected in the Science Library, and will represent about a million entries. The essence of the scheme is that each subject is denoted by a number. Titles of papers, or other recorded information, are numbered according to the subject to which they relate and pasted on cards of uniform size. When the cards are arranged in numerical order, which is done by unskilled labour, all the cards relating to information on a given subject fall together, no matter by what agency the titles were numbered. There is a copious alphabetical index of subjects, so that, to find what information has been indexed on a given subject, all that is necessary is to look for the number in the A,B,C, and then find the drawer which contains the cards bearing that number. This is a matter of a few moments, instead of the several weeks which would be necessary to consult all the parts of the miscellaneous bibliographies that might contain references to the subject of inquiry.

The material, which has been gathered in the Science Library, is now being arranged and made available for use. In a few months its extent will be approximately as follows:—

Subject.	No. of Bibliographical References.	Approximate period covered. From
Mathematics	100,000	1893
Physics	15,000	1903
Geology	48,000	1901—1904
Biology—		
General biology, Palæontology, Zoology, Anatomy, Physiology	200,000	1896
Steam and locomotive engineering	39,000	1903
Electrical engineering	61,000	1903
Telegraphy and telephony	2,700	1903
Motors, transmissive machinery machine tools and workshop practice	45,000	1903
Mining and economic geology	30,000	1903
Bridges, roads, railways	33,500	1903
Canals, docks	10,000	1903
Hygiene, public health	11,000	1903
Water and road transport	19,000	1903
Aviation	4,500	1903
Communications, transport	19,000	1903
Chemical technology	76,000	1903
Metallurgy	39,000	1903
Building construction	10,000	1903
Agriculture, economic botany, and forestry	250,000	1919
Other subjects	100,000	1903
Total	1,112,700	References.

The marshalling of this mass of bibliographical material will complete the organisation in the Science Library of an information service covering the whole field of science and technology, arrangements having been made for bibliographical researches to be undertaken by its expert staff on subjects which are still insufficiently covered by the subject-matter index. It will be seen that the index will be particularly strong in engineering subjects, and should be, in fact, by far the most extensive bibliography of engineering that has been organised in this country.

It is intended that other important bibliographies, which are not classified by the Brussels system, should be reclassified gradually, so that their entries also may be interpolated in place in the general card-index with all collected references to the same subjects. At the same time an appeal is made to bibliographical undertakings generally, which are invited to co-operate with the Science Library in the production of a really comprehensive subject-matter index to recorded information by adopting the Brussels Decimal Classification for all published bibliographies, in order that the entries may be cut up, mounted on cards, and all references on each subject brought together.

The index will be available for consultation, by permission, in the library, while, for those who are unable to visit the library, lists of books and papers will be typed or photographed from the cards so far as the general work permits. Photostat copies of articles can also be supplied at cheap rates.

Some Thoughts on Coal Pulverisation.

By P. V. VERNON, M.I. Mech. E.

IN the following observations coal has been taken as the object to be pulverised, but what is written is probably equally applicable to other substances so long as they are capable of being pulverised by any of the usual processes.

Pulverisation by any of the methods in common use, from the pestle and mortar upwards is rather a happy-go-lucky process, and one cannot be sure how much of the energy consumed in the pulveriser is used in actual pulverisation and how much is wasted in friction, in buffer action, in unprofitable agitation, misdirected blows, useless eddies and unnecessary air currents. What we do know is that the proportion of wasted energy is enormous, and that there should be great possibilities of increased efficiency. Mr. Geoffrey Martin has shown that with some pulverisers (tube mills) working on sand the efficiency is not more than 1 per cent.; in other words, 99 per cent. of the power required by the machine is wasted. There is little reason to expect better results on coal.

We know that some pulverisers are more economical than others in the use of power, but what we do not know is how much more economy is possible. We do not know how much—perhaps we should say how little—energy need be required to pulverise a given material from a certain size to a given fineness, but only how much energy is absorbed by a given machine in producing the required result. Neither do we know how much power is wasted in pulverising part of the material finer than is required. Large coal is always accompanied by small coal, and small coal by still smaller coal, "and so *ad infinitum*," the smaller coal being adventitious, unnecessary or even undesirable and wasteful in the power consumed in producing its fineness. This is, of course, true even of the fine coal that has passed through the finest sieve, such as the 180 or 200 mesh sieves generally used for testing pulverised coal.

Suppose an experimental device to be made to split a unit piece of any material such, for example, as coal, into two pieces. The energy consumed could be measured, and it is possible that the best way of splitting could be discovered by trying various methods and various kinds of splitting processes. We might, for example, find out whether it takes more power to split coal with a tool than to break it up by hitting it with another piece of coal without any splitting tool, by mutual collision, in fact. Suppose further that each of the assumed two pieces of coal could be cut in half and the best way of doing it discovered and the energy measured and so on for a series of bisections; we should possibly be able to frame a law from which the lowest power required to pulverise a given size of material down to a specified fineness could be calculated. It is beyond doubt that the power so ascertained would be a small fraction of that actually required by any existing pulverisers and would give a figure to aim at when carrying on further experimental work in the design of the machines.

Present pulverising processes are very casual in their action. With some machines the material is squeezed more or less in bulk, pieces are pressed, rubbed or rolled on each other, or on the grinding or crushing elements of the pulveriser; with others they collide in mid-air and knock corners off each other. Sometimes several or all of these processes are going on at the same time. Some pieces get too much hammering and some not enough. We cannot order their comings and goings, their passings and repassings in such a way as to avoid useless work. There is a field for investigation here.

In the course of experimental work on coal pulverisers in which the pulverisation is carried out by the collision of particles in the presence of air eddies surprising effects have been found to result from seemingly unimportant changes of design which have resulted in reducing the power required to less than half what it was at the outset of the experiments. It would be absurd to reason that finality has been reached, particularly as many of the experiments have been made in the dark, and, although intelligently guided, have been largely empirical and exploratory. A simple rule has, however, emerged from the experience gained—not to apply means of fine pulverisation to coal that is not already approaching fineness, but to graduate the means to the increasing fineness as the coal progresses from inlet to outlet.

In some processes the pulverisation is admittedly imperfect in the machine, and in order to obtain a reasonably uniform product, the coal consisting of large and small pieces mixed is taken outside the machine and subjected to a process of "air separation," or "elutriation," as it is called, which means that the fine pieces are carried along in a current of air, the larger pieces, or "nibs" having a smaller surface compared with their mass, remaining behind and later being returned to the pulveriser for further treatment. It is conceivable that individual particles treated in this way might pass round and round through pulveriser to separator and back to pulveriser many times with consequent waste of energy in transportation. When coal is carried in a current of air the speed of the coal must be less than that of the air carrying it as, if the same, the coal would fall to the lowest point, and it is only the slip or friction of the air and some degree of turbulence in the current that carries the coal along at all. Friction means heat and waste of energy, otherwise loss of power, and here again there seems to be need for further knowledge and experiment.

In some pulverisers the whirling mixture of pulverised coal and air pass through a central exit, and while approaching this aperture from the larger internal diameter of the pulveriser the air current and centrifugal force are in opposition, the result being that centrifugal force keeps the larger particles back; but the greater air friction in proportion to the mass of the smaller particles enables the air current to overcome centrifugal force and to carry them out. The effect is that of a screen without its disadvantages and of a separator without its bulk.

To show that some progress is being made in the art of pulverisation, the following figures may be of interest as applying to an actual machine of the "Air-Beater" type pulverising standard coal:—

	Per ton.
Capacity of machine, 2 tons per hour.	
Total power absorbed on full load pulverising 2 tons per hour ..	40 H.P. = 20 H.P.
Power absorbed by motor running light	2 H.P.
Power absorbed by machine and feeder with pulverising elements removed, running light	1·9 H.P.
Power absorbed by pulverising elements running light	3·5 H.P.
Power absorbed by fan (1250 r.p.m.) running light	9·6 H.P.
Total power absorbed running light	17 H.P. = 8·5 H.P.
Difference, being actual power consumed in pulverising the coal and in propelling it from the machine	23 H.P. = 11·5 H.P.

It is doubtless too much to expect that 100 per cent. efficiency in pulverisation will be approached, but it may be seen that something rather better than 1 per cent. is not altogether out of reach.

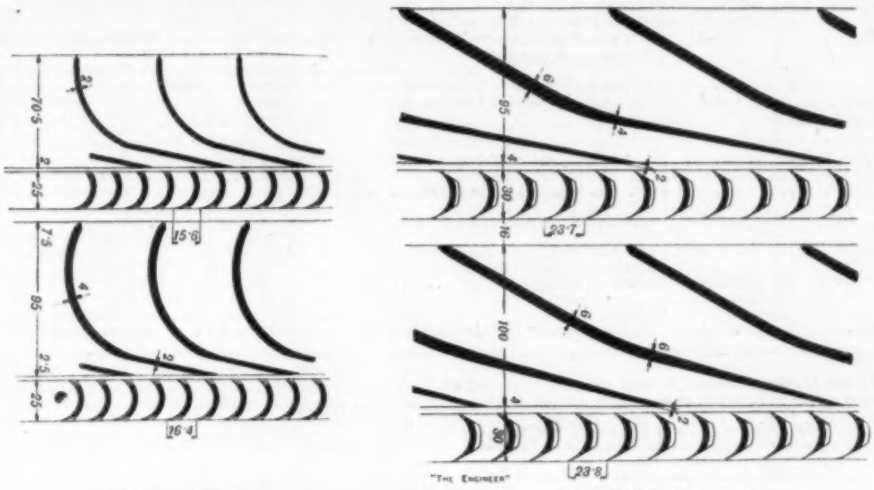
Tests of a 12,000 kW Zoelly Steam Turbine.

IT will be remembered that careful tests were carried out in December, 1926, by Professor Stodola on a Zoelly turbine rated at 11,000 kW., supplied by Messrs. Escher Wyss and Co., of Zurich, to the Wehrden Power Station in Westphalia. The tests which were discussed by Professor Stodola, at considerable length in the *Zeitschrift des Vereines Deutscher Ingenieure* last year, Vol. 71, page 747, showed that at full load an efficiency of 81·6 per cent. was secured, based on the output at the coupling, and the steam conditions before the main stop valve and in the condenser. The average "blade efficiency," including disc friction, leakage losses and windage amounted to 83·9 per cent., and a "blade efficiency" as high as 90 per cent. was calculated for the blades of the sixth stage, this figure excluding disc friction and leakage losses. The turbine in question was a 10-stage impulse machine, with wheels having mean blade dimensions ranging from 1200 mm. (47·2in.) to 1600 mm. (63in.). The turbine operated with a steam pressure of about 200 lb. per square inch absolute and temperature of 660 deg. Fah. and a vacuum of about 28·75in. Its speed was 3000 revolutions per minute, and the results were considered remarkable, as showing the possibilities of a single-cylinder machine for such an output.

We have now received from Professor D. Dresden, of the Hague, particulars of tests carried out by himself on a similar machine, having a slightly greater rating and using a higher steam pressure and temperature. The turbine in question was supplied by the same makers to the City of Leiden, and the tests were made in June, 1927. It was designed for a normal steam pressure of 285 lb. per square inch (gauge) and a total temperature of 662 deg. Fah. The speed was 3000 revolutions per minute. The machine comprised ten simple impulse wheels with diameters ranging from 51in. to 69in., the blade speed being therefore somewhat higher than in the case of the Wehrden machine. Table I. above gives particulars of the blading and nozzles, while the results of the tests are shown by Table II. It may be mentioned that a special arrangement was made when the machine was ordered, under which a representative of another firm of turbine builders should be allowed to be present at the tests and to inspect the apparatus. This arrangement was carried out, and the official report was signed by the representative in question.

We do not illustrate the machine as it represents the standard practice of the makers. Particulars, however, of some of the nozzles and blading are shown in a diagram, which illustrates these details for stages 1, 2, 9 and 10 respectively. With regard to the method of conducting the tests, it will be remembered that at Wehrden, Dr. Stodola made elaborate arrangements to determine the absolute pressure in the exhaust end, but some uncertainty still remained concerning the actual pressure of the steam leaving the last row of blades. At Leiden, it was proposed by Dr. Dresden to measure the temperature at points, at the ends of the two sides of the exhaust branch and 400 mm. above the centre line of the turbine, where the casing metal sloped downwards at an angle of about 45 deg. The temperature there being known, the pressure could be taken as that of saturated steam at this temperature. The designer of the turbine, did not, however, see eye to eye with Dr. Dresden in this matter, so the table of results mentions only the pressure at the condenser inlet, measured by means of an open mercury tube and an accurate barometer. The efficiencies were calculated on the basis of this pressure, so that they are not directly comparable with the values given for the Wehrden machine. From the temperatures measured at the points on the breeching, above referred to, and from comparison with the Wehrden results, Professor Dresden deduces that a difference of pressure amounting to 0·0425 lb. per square inch existed between the last row of blades and the condenser inlet during the full load test.

The efficiency of the alternator was not measured, the values given in the table being based on the calculated losses. The figure 95·37 per cent. at full load and 89 per cent. power factor, is considered fairly high in comparison with efficiencies obtained from similar machines. This is, of course, against the turbine, and Professor Dresden thinks that the latter might really be credited with about 0·5 per cent. higher efficiency than the table shows. The last line in the table gives a check on the measurements. The results, taken together, are in satisfactory agreement with the figures obtained by Dr. Stodola, when due account is taken of the leaving losses and the Parsons "K" factor. They may be regarded as very favourable for a single cylinder machine of such a size working with a high vacuum.



STAGES 1 AND 2 STAGES 9 AND 10

BLADING OF 12,000 kW ZOELLY TURBINE

TABLE I.—*Blading Particulars of* 12,000 *kW Zoelly Turbine.*

Stage number	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Mean blade diameter, inches ..	51	53·3	56·2	58·6	61	63·4	66	67·5	68·5	69
Nozzle angle	14	14	14	12	12	11	11	11	12	17
Entrance angle buckets	24	33	33	28	28	28	28	28	28	33
Outlet angle buckets	20	20	20	20	20	20	20	20	20	30
Radial nozzle height, inches ..	0·33	0·5	0·575	0·845	1·14	1·8	2·74	4·9	8·61	13·8

TABLE II.—*Tests of* 12,000 *kW Zoelly Turbine at Leiden.*

Test number	1.	2.	3.
Time in seconds	3,646	3,619	3,379
Condensed steam, lb. per hour	116,300	94,000	63,690
Temperature condensate, deg. Fah.	86·5	83·5	79
Gland steam, lb. per hour ..	358	150	66
Total steam consumption, lb. per hour	116,658	94,150	63,666
(1) Gauge pressure, lb. per sq. in. at stop valve ..	271	271	275
Total temperature live steam, deg. Fah. ..	720	694	673
(2) Gauge pressure, lb. per sq. in. at nozzles ..	248	194	124
(3) Absolute pressure, lb. per sq. in. at condenser inlet	0·74	0·648	0·582
Adiabatic heat drop (1) to (3) in B.Th.U. per lb. ..	451·5	451·4	450·7
Adiabatic heat drop (2) to (3) in B.Th.U. per lb. ..	447·5	433	408
Load in kW	12,177	9,491	6,122
Cos φ	0·89	0·835	0·85
Efficiency of alternator in per cent.	95·37	95·08	94·3
Steam consumption in lb. per kWh	9·6	9·9	10·36
Efficiency ratio in per cent. referred to heat drop (1) to (3)	82·6	80·4	77·3
Efficiency ratio in per cent. referred to heat drop (2) to (3)..	83·45	83·8	85·4
Cooling water inlet, deg. Fah.	64·6	65·7	66·1
Cooling water outlet, deg. F.	75·5	74·7	72·2
(4) Lb. per hour of steam going through turbine, reduced to total temperature of 662 deg. F.	122,000	96,200	64,200
Value of (4) divided by absolute pressure at nozzles..	466	464	465

B.E.S.A. SPECIFICATIONS.

SPECIAL TRACKWORK FOR TRAMWAYS.

THE first revised edition of the British standard report No. 79, "Special Trackwork for Tramways," has just been issued by the British Engineering Standards Association. The report was first published in 1919. In the revision the holding arrangement for the 5½in. (133·35 mm.) rail has been superseded by a similar diagram for a 5in. (127·00 mm.) rail, corresponding to the new British standard section No. 10, and plates are given showing the complete details of the holes. The position from which the reduced depth of groove at intersections of the open make of switches and crossings is to be measured is indicated, and the depth of groove at this point has been increased from ½in. (12·70 mm.) to ⅝in. (15·88 mm.). Approximate metric equivalents for all the dimensions in the report are now included. Copies of the report—No. 79, 1927—can be obtained from the publications department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

ARRANGEMENTS have been made by a Detroit firm for developing the chromium mines on the Bonaparte River near Ashcroft, British Colombia.

Tank Engines on Express Trains.

IN our issue of February 3rd we printed long excerpts from Colonel Sir John Pringle's report to the Ministry of Transport on the Sevenoaks derailment. To-day we take from the appendices to that report certain particulars which are of interest to our readers in connection with the employment of tank locomotives. We give, in the first place, a table which shows the speed attained by tank engines on the Great Western, London, Midland and Scottish, and London and North-Eastern railways :—

TABLE I.—*The Timing and Speeds of Trains Hauled by Various Types of Tank Engine.*

Railway.	Tank engine.	Train.	Section.	M.	Ch.	Time allowed.	Average speed.	Remarks.
						Minutes.	M.p.h.	
G.W.R.	2–6–2	4.33 p.m. Paddington to Windsor ..	From Paddington To Southall	9	6	12	45·37	Starting from rest
			,, Southall ,, W. Drayton	4	12	5	49·80	Through running
			,, W. Drayton ,, Slough	5	18	6	52·25	Finishing at rest
.. .. ..	,,	8.10 p.m. Carmarthen to Swansea ..	,, Carmarthen Jnc. ,, Llanelly	10	57	23	51·42	,, ,,
.. .. ..	4–4–2	11.15 a.m. Reading to Paddington ..	,, Reading ,, Maidenhead	11	59	14	50·30	Starting from rest
			,, Maidenhead ,, Slough	5	63	6	57·87	Through running
			,, Slough ,, Southall	9	30	9	62·50	,, ,,
			,, Southall ,, Paddington	9	6	11	49·50	Finishing at rest
L.M.S.R.	,,	4.55 p.m. Euston to Tring	,, Willesden ,, Watford	12	0	14	51·43	Through running
			,, Watford ,, Boxmoor	7	0	9	46·66	Finishing at rest
.. .. ..	,,	9.1. p.m. Westcliff to Fenchurch-st. ..	,, Pitsea ,, Upminster	11	20	15	45·00	Through running
			,, Upminster ,, Barking	7	60	9	51·67	,, ,,
.. .. ..	0–6–4	8.30 a.m. St. Albans to St. Pancras ..	,, St. Albans ,, Hendon	13	0	15	52·0	Starting from rest
			,, Hendon ,, Kentish Town	5	40	6	55·0	Through running
.. .. ..	4–6–2	2.20 p.m. Chester to Manchester	,, Kenyon Jnc. ,, Barton Moss	7	0	7	60·0	,, ,,
.. .. ..	,,	5.25 p.m. Shrewsbury to Crewe	,, Whitchurch ,, Nantwich	9	20	10	55·5	,, ,,
.. .. ..	4–6–4	5.10 p.m. Glasgow to Ayr	,, Glasgow ,, Ayr	41	20	50	49·5	Start to stop
			,, Beith N. ,, Dalry Jnc.	5	20	5	63·0	Through running
			,, Dalry Jnc. ,, Kilwinning	3	0	3	60·0	,, ,,
L.N.E.R.	4–4–2	5.8 p.m. Glasgow to Helensburgh	,, Clydebank C. ,, Dumbarton E. Jnc. ..	7	0	8	52·5	,, ,,

In Table II. the numbers of tank engines operating on standard gauge railways in this country are set down.

TABLE II.—*The Numbers of Tank Engines of Various Classes, &c., Owned by Different Railway Companies at December 31st, 1926.*

Wheel type.	S.	G.W.	L.M. and S.	L. and N.E.	Other stand'd gauge Co's.	Great Brit'n.
2–2–4	—	—	—	4	—	4
0–4–0	30	35	125	76	16*	277
0–4–2	79	155	23	4	4	265
0–4–4	391	6	377	213	20	1,007
2–4–0	8	122	21	—	5	156
2–4–2	1	44	539	322	—	906
4–4–0	—	—	60	17	9	86
4–4–2	69	31	148	163	4	415
4–4–4	—	2	—	45	8	55
0–6–0	166	1,222	1,278	1,017	112*	3,728
0–6–2	136	473	490	640	4	1,743
0–6–4	5	4	64	9	4	86
2–6–0	—	—	1	—	—	1
2–6–2	4	200	—	—	—	204
2–6–4	21	—	2	20	6	49
4–6–2	7	—	59	74	—	140
4–6–4	7	—	29	—	—	36
0–8–0	—	—	6	—	1	7
0–8–2	—	10	32	41	—	83
0–8–4	—	—	30	4	—	34
2–8–0	—	175	—	—	—	175
4–8–0	4	—	—	15	—	19
2–8–8–2 ..	—	—	—	1	—	1
Total ..	928	2,479	3,284	2,665	193*	9,477
Total tender engines ..	1,196	1,511	6,872	4,743	155	14,477
Grand total...	2,124	3,990	10,156	7,408	276	23,954

* Including Manchester Ship Canal.

From another table which we do not reprint, we learn that passenger tank engines of the "K" and "K 1" class of the Southern Railway—the "Rivers"—numbered in all twenty-one, and had made 1,181,446 miles in all up to August 10th, 1927—"No. 790," the first of the class, built in 1917, having completed 316,973 miles.

The question of the height of the centre of gravity of locomotives having been discussed, the following particulars will prove of interest :—

TABLE III.—*Height of Centre of Gravity of Various Engines on the Southern Railway.*

Tank Engines—
(1) 2–6–4 "River" class (two and three-cylinder types) :—
5ft. 5½in., in full working order.
5ft. 4½in., with reduced water and coal.
(2) 4–6–4 "Baltic" class (Central Section) :
5ft. 8½in., as now running.
(3) 4–6–2 "J" class (Central Section) :
5ft. 5½in.

Tender Engines—
(4) 4–6–0 "King Arthur" class, two-cylinder :
5ft. 6in.
(5) 4–6–0 "Lord Nelson" class :
5ft. 7½in.

Weights, &c., of "King Arthur" class—
Weight of engine, 80 tons 19 cwt.
Weight of tender, 57 tons 11 cwt.
Coupled wheel base, 14ft. 6in.
Weight on coupled wheels, 60 tons.

We now turn to Appendix VI. and Appendix VII., which are the reports by Mr. H. N. Gresley and Mr. J. L. M. Moore upon the special trials made on the L. and N.E.R. and the S.R. with tank engines.

From Mr. Gresley's report we take the following passages and tables :—

I have carried out a series of running trials at high speeds with tank and tender engines of the Southern Railway.

These trials were made on October 16th between Huntingdon and St. Neots on the Great Northern Section of the London and North-Eastern Railway main line, and were repeated on October 30th between Woking and Walton on the Western Section main line of the Southern Railway. Diagrams showing gradients, curvature and super-elevation of the line between Huntingdon and St. Neots are shown and similar particulars of the line between Woking and Walton are given. (See page 179.)

The engines used in both series of trials were :—
(1) "No. 803" 2–6–4 tank engine, two-cylinders.
(2) "No. 890" 2–6–4 tank engine, three cylinders.
(3) "No. 782" 4–6–0 tender engine, two cylinders.

In order to attain quickly a high rate of speed on the trial runs, only two carriages were attached to the engine, one of these being a dynamometer car for accurately recording the speeds during the trials.

On all the trials I rode on the footplate to instruct the drivers as to the speeds and observe the oscillation and the running of the two tank engines. Compared with the tender engines, they ride more softly and more comfortably. When on a bad piece of road the period of the roll of the tank engines is longer and easier, but, I think, of greater amplitude. The tender engine has stiffer springs, consequently rides more rigidly and the roll is shorter. I should expect that the running of the tender engine would be more detrimental to the road at high speeds than that of the tank engines.

The two-cylinder engine "No. 803" is slightly steadier than the three-cylinder "No. 890," probably because "No. 803" has laminated springs on the pony truck and bogie, whereas on "No. 890" helical springs are used.

TABLE IV.—*Trials with Southern Railway Engines on London and North-Eastern Railway, October 16th, 1927.*

No. of trial.	Engine.	Direction of running.	Road.	Condition of tanks and bunkers.	Speeds.	Observations.
Tank engines Nos. 803, 890.						
1	803	Forwards	Up	Nearly empty	67¼—73¼	Engine ran without roll or lateral motion on straight and on curves except for a slight roll at about 55¼ mile post, and again a lesser roll at 54¼ mile post.
2	803	Backwards	Down	Nearly empty	67—73¼	Engine ran quite smoothly and without any rolling or lurching.
3	890	Forwards	Up	Nearly empty	73½—77	Engine rather more lively on its springs than 803 and not quite so steady. A slight roll was noticeable at 55¼ mile post and at 54¼ mile post ; otherwise she ran smoothly and did not roll.
4	890	Backwards	Down	Nearly empty	77¼—83¼	A very satisfactory trial ; engine ran, if anything, steadier than 803, bunker first, and there was no rolling nor lurching, although 83¼ m.p.h. was attained.
5	803	Forwards	Up	Full	72¼—78	Engine ran steadier than when empty on No. 1 trip. In fact, considering speed, it could be regarded as being on this trip a very steady, comfortable riding engine.
6	803	Backwards	Down	Full	68—77¼	Running of engine very steady and smooth throughout trip.
7	890	Forwards	Up	Full	74—77¼	Not quite so steady as engine 803, Trip 5, but better than when running with tanks and bunkers empty on Trip 3.
8	890	Backwards	Down	Full	69¼—79	Engine ran very steadily.
9	803	Forwards	Up	¾ full	56¾—59¼	These trials at reduced speeds were carried out at the suggestion of the Chief Engineer of the Southern Railway with a view to learning whether, at lower speeds, any periodical oscillation might be set up. The engines ran quite steadily and without any noticeable oscillation.
10	803	Backwards	Down	¾ full	62¼—66¼	
11	890	Forwards	Up	Nearly empty	61¼—68¼	
12	890	Backwards	Down	Nearly empty	57¼—64¼	
Tender engine No. 782.						
15	782	Forwards	Up	Ordinary running conditions	75—81¼	The engine ran with perfect steadiness without any roll or lurch, but the vibration on the footplate was so great that it was impossible to obtain any record with the accelerometer.

TABLE V.—*Trials with Southern Railway Engines on Southern Railway, October 30th, 1927.*

No. of trial.	Engine.	Direction of running.	Road.	Condition of tanks and bunkers.	Speeds.	Observations.
Tank engines Nos. 803, 890.						
1	803	Forwards	Up	Nearly empty	44¼—63	Only moderate speed was attempted on this run ; engine rolled slightly at several points and was not so steady as on L. and N.E.
2	803	Backwards	Down	Nearly empty	34¼—69¼	Only moderate speed was attempted. Engine rode steadier than in No. 1 Trip. Down road appeared to be in better condition than up road.
3	890	Forwards	Up	Nearly empty	51¼—77¼	Engine rolled at several points on this trip, but quickly recovered itself, five oscillations being the greatest number occurring together in close succession. These oscillations or rolls were the worst experienced in any of the trials. Some were on the straight road, others on entering curves, and again where super-elevation of outer rails changed. I did not regard the rolling as actually dangerous, but if it had increased instead of abated, should have promptly applied the brake.
4	890	Backwards	Down	Nearly empty	31—69¼	Engine rode much better than on the up road, the speed was lower than in preceding run, and the road in better condition. There was a slight roll at 19¼ mile post.
5	803	Forwards	Up	Full	50—77¼	The engine rolled to about the same extent as engine 890 on Trip No. 3 and at the same places.
6	803	Backwards	Down	Full	31—73¼	Engine ran fairly steady and better than when empty.
7	890	Forwards	Up	Full	52¼—68	Speed reduced on this trip owing to instruction received from chief engineer, but rolling still considerable at bad points.
8	890	Backwards	Down	Full	33¼—70¾	Engine running was fairly satisfactory and seemed rather better than on Trial 4 when empty. There were some vertical oscillations but no rolling to speak of. (Sir John Pringle rode on footplate.)
Tender engine No. 782.						
9	782	Forwards	Up	Ordinary running conditions	66¾—86	The vibration was, if anything, worse than on the London and North-Eastern. At the places where rolling occurred with the tank engines there was considerable rolling and lurching with the tender engine, and the riding can be described as being very rough and uncomfortable.

General Conclusions.—There is little difference between general behaviour of the engines. Mr. Moore, of the Ministry of Transport, also rode on the footplate. In addition, two of my staff were on the footplate taking records with a portable accelerometer made by the Cambridge Instrument Company, which recorded the vertical and lateral accelerations of the engines. The weather conditions during the trials were similar, being fine and clear, and the same drivers were employed on both occasions.

The coupled wheel springs are similar on both engines, the leading and trailing coupled wheels having laminated springs and the centre coupled wheels helical. I think engine "890" would probably ride as well as "803" if laminated springs were fitted to the pony truck and bogie. In other respects "890" is the better engine of the two.

When running backwards, bunker first, with the bogies leading, the riding of both tank engines was distinctly steadier than when running forwards with the pony truck leading.

Both engines ran noticeably steadier when water tanks and coal bunkers were full than when they were practically empty.

There is a very marked difference in the conditions of the sections of the tracks of the London and North-Eastern and Southern railways over which the trial runs were made. Both the tank and tender engines ran with remarkable steadiness at high speeds on the London and North-Eastern track. The curves are all transition curves, and the general condition of the road was superior to that of the Southern. I am satisfied that on the London and North-Eastern section of the road over which the trials were made both tank and tender engines could run regularly with safety at any speed which they could attain. Both the tank engines are well designed efficient engines, and on a road well laid and well maintained are suitable for working express passenger trains.

Mr. Moore's impressions received whilst travelling on the footplate on these trials were :—

(*a*) In respect of the London and North-Eastern Railway section, the steadiness of the tank engines was particularly noticeable throughout, and on no occasion was anything in the nature of a continuous roll set up. The directional changes in curvature were negotiated more smoothly on the trial runs when the tank engines were running bunker first, *i.e.*, with the bogie wheels leading, than in the opposite direction, when there was a tendency at first to lurch. The engines appeared to be rather steadier when travelling with side tanks full, and "No 803," two-cylinder, was less susceptible to irregularities in the track than "No. 890," three-cylinder.

As regards the trial runs with tender engine "No. 782" —"King Arthur" class—there was smooth running with little oscillation noticeable on the first trial when the maximum speed of 72 miles per hour was attained. On the second trial when the speed of about 82 miles per hour was reached, slight but steady rolling was set up on two occasions, but the effects of the variations in curvature were hardly noticeable. Vibration of the footplate was more pronounced than in the case of either of the tank engines.

(*b*) On the Southern Railway section the tank engines did not run so steadily, and distinct periods of oscillation of short duration were experienced when travelling on the up main line—more or less at the same places on each run. As there were no directional changes of curvature to account for them, he thought the movements were probably the result of imperfections in the permanent way. On the down track the rolling movement was less noticeable, which suggested to him that the track might be in better condition, though the improvement might possibly have been due again to the fact that the bogie of the tank engines was in front. Engine "890" again appeared to be slightly less steady than "803." On one occasion when travelling with the former—tanks full—on the up line, a slight jar was felt, giving the impression that the framing of the engine had come in contact with the tops of the axle-boxes on one side during a roll.

On the one trial made with engine "No. 782," when a maximum speed of about 86 miles per hour was attained, a certain amount of oscillation was experienced, such as might be expected on any engine travelling at so high a speed, and several rather pronounced shock rolls occurred at the same points on the up line, very similar in degree to those experienced on the tank engines. Vibration was again very marked, suggesting that the springing of the engine was somewhat harsh.

(*c*) Mr. Moore concluded that he did not consider that any of the engines showed any marked tendency to roll continuously. When their steadiness was disturbed by imperfections in the track or other causes, the oscillation was neither excessive in his view nor of long duration. The rapidity with which the engines settled down after rolling was noticeable.

In view of the greater number of trials made with the tank engines, he found it difficult to draw a fair comparison of their movement with the tender engine. There appeared to be very little difference between the three engines with regard to rolling movements when they were travelling with the bogie wheels leading. In the other direction the tank engines were slightly less steady, and more inclined to lurch and develop rolling movement when encountering directional changes of curvature. The greater "liveliness" which was shown by engine "No. 890" as compared with "803," he thought was probably due to the difference in the springing arrangements between the two engines.

THE date for the removal of the London, Midland and Scottish Belfast steamship services from Fleetwood to Heysham has been provisionally fixed for May 5th.

South African Engineering Notes.

Order for British Firm.

THE long sequence of railway contracts given to foreign firms has been broken at last by the award of a £170,000 contract for fifty second-class main line coaches to the British firm, Metropolitan Carriage, Wagon and Finance Company, Ltd., Birmingham. While the British tender was not the lowest, it was considered, technically, more favourable, and another factor was the remarkably quick delivery offered by the British firm.

Steenbras Waterworks.

The working of raising the dam of the Steenbras Reservoir by 40ft. and thereby increasing its storage capacity from 784 million gallons to 6000 million gallons, was completed in June last. In order to enable the city of Cape Town to avail itself of a portion of the additional daily supply, estimated to have been provided by the greater storage, it became necessary to lay another pipe line connecting with the existing Newlands service reservoir. The pipe line at present in service is composed of 30in. cast iron pipes, and conveys water to a service reservoir situated on the mountain slope above the city. The new pipe line is of steel, 33in. internal diameter, lined with a half inch layer of cement, the lining being carried out by the Hume Pipe Company (S.A), Ltd. The total length of the line will be about 33 miles. The outside surfaces of the pipes are protected by wrapping them in hessian, heavily impregnated with bitumen. Each pipe is 26ft. 3in. in length and weighs about 3¼ tons. The cost of each pipe, exclusive of laying, is approximately £60. The complete line will require the laying of 6807 of these pipes and 405 specials, and the total weight of the pipe line will approximate to 22,500 tons. Such good progress has been made with the laying of the line that it has now reached Claremont, only a mile or two from the service reservoir. At the beginning of December the total quantity of water stored in the Steenbras and Table Mountain reservoirs of the city was 5,644,297,000 gallons, as compared with 2,138,394,000 gallons at the same date in 1926, the increase being, of course, due to the raising of the dam at Steenbras. The total daily average consumption of the city during the month was 8,345,000 gallons, while for the corresponding period of 1926 it was 7,640,000 gallons. At present about 1,000,000 gallons daily are obtained from springs. The maximum amount supplied from the Steenbras Reservoir in any one day has been 6,500,000 gallons, but when the new line is completed about double that quantity will be available. When necessary the last instalment of the Steenbras scheme can be carried out, and then a daily supply of 20 million gallons will be available.

Road Motor Services.

Some idea of the rate of growth of the Railway Administration's road motor services can be gathered from the following statistics :—At March 31st, 1927, a route mileage of 4282 was being operated. The distributions and increases in the past twelve months are as follows :—Cape, 1494 (+ 1167) ; Orange Free State, 163 (+ 163) ; Natal, 460 (+ 460) ; Transvaal, 2110 (+ 886) ; and South-West Africa, 55 (unchanged). The aggregate mileage run by the vehicles during the year ended March 31st, 1927, was 1,218,783. Writing under date October 31st, Sir Wm. Hoy, General Manager of the Railways, stated that further services had since been introduced, representing 946 route miles and giving a total route mileage to that date of 5228. The following figures show the work done and the earnings and expenditure during the last two financial years :—

	1925–26.	1926–27.	Increase.
Passengers carried	297,407 ..	493,924 ..	196,517
Goods conveyed, tons ..	9,997 ..	24,891 ..	14,894
Route mileage	1,551 ..	4,282 ..	2,731
Earnings	£32,207 ..	£79,885 ..	£47,678
Expenditure	£30,600 ..	£82,558 ..	£51,958

Trials took place at Cape Town at the end of October on a new type of railway omnibus built at the Salt River works for country road motor services. The body will accommodate ten first-class and twenty third-class passengers, together with baggage and produce. The chassis is a Thornycroft fitted with a 36 H.P. engine.

Private enterprise is also moving in the direction of providing road services. Coaches have just been put on between East London and Kingwilliamstown, a distance of about 38 miles. They are fitted with Leyland engines of 80–100 H.P., driving through a four-speed gear-box and governed so that no more than a fixed maximum speed can be attained on any one gear, the maximum on top gear being 40 miles per hour. At Durban a municipal omnibus service has been established between the city and the new suburb, Durban North, the two places having recently been connected by a fine bridge over the Umgeni River. The service is maintained by four motor omnibuses, viz., three twenty-passenger "Thornycroft" vehicles and a thirty-two-passenger "Tilling-Stevens" purchased for £1250. Tenders were recently received for two additional thirty-passenger omnibuses, or, alternatively, two chassis, but no acceptance has yet been reported.

At the moment of writing one of the longest routes operated by the S.A.R. road motor services has been opened. The route is from Potgietersrust to Van Wyksfontein, near the Bechuanaland border, and is 170 miles in length. An overnight stop has to be made. Two services are to be given in each direction weekly, and the vehicles to be used are the latest type of six-wheelers.

Platinum Extraction.

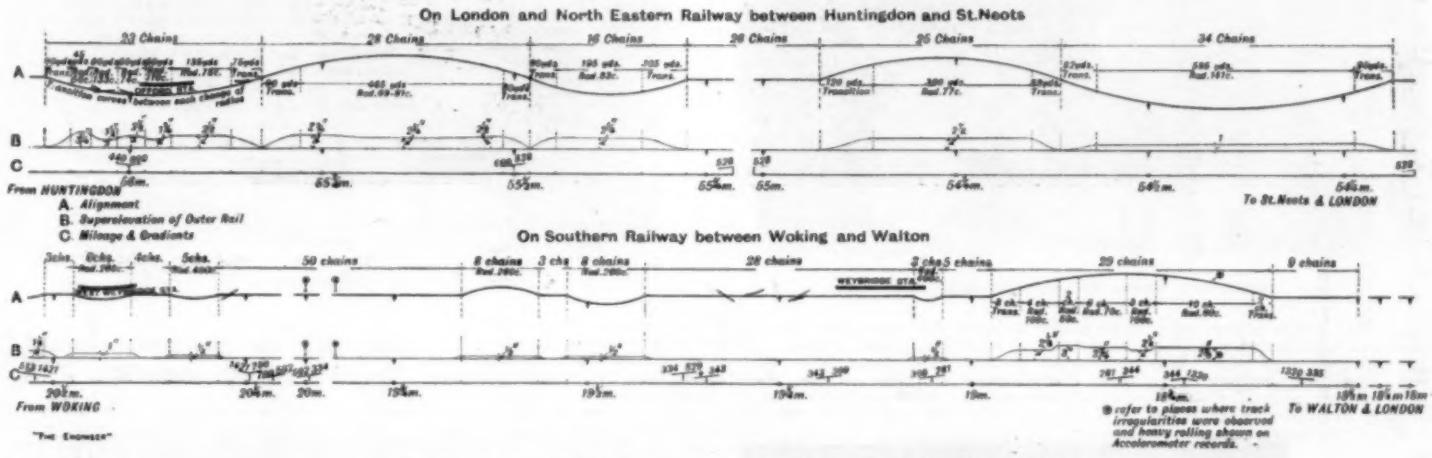
Considerable progress is being made in improving the percentage of recovery from the platinum ores of the Transvaal. At the Onverwacht platinum mine—the unique pipe occurrence which has become so famous—a recovery of 83 per cent. has been reached. During November the reduction plant treated 2266 tons and the crude platinum produced is estimated to yield 631 oz. of refined platinum and allied metals, equivalent to 5·56 dw. per ton milled. As the working costs run about £6 16s. 9d. per ounce of platinum produced, it will be seen that there is a good profit.

All the platinum undertakings with the exception of Onverwacht, have been, and are, experiencing considerable difficulty in the extraction of platinum from the ores, which vary greatly, some being exceedingly refractory. It is satisfactory, therefore, to find that steady progress is being made in overcoming these difficulties. In the Rustenberg district, now regarded as the field holding out the greatest promise—not because the grade of the ore, though very good, is above that at such fields as the Potgietersrust, but because the percentage of platinum is high compared with most of the other districts where the percentage of the allied metal palladium is considerable—much research work has been carried out. At the annual meeting of the Erstegeluk platinum mines (Rustenberg district), held recently, Sir Julius Jeppe made an exceedingly important and encouraging statement on the position and prospects of the platinum industry, in the course of which he said :—"We have done, and we are doing, much to solve the difficult problems of extraction, and our technical advisers are confident that before very long a practical and economical process will be found. If these hopes are realised—and I personally feel sure they will be—then there remains only the question of stabilisation of the metal's value to assure the establishment of a very prosperous mining concern."

Mineral Production.

The mineral production of the Union for the month of October was £5,005,689, compared with £5,278,792 for October, 1926. The decrease is entirely due to a drop in the production of diamonds, probably caused by the passing of the Precious Stones Bill, which gives the Government some measure of control over the production of the alluvial diggings, and to the decreased price obtained per carat, except for good quality stones. For the ten months ended October 31st the total value of the mineral production was £50,967,051, compared with £48,307,973 for the corresponding period of 1926. Gold at £35,809,433 showed an advance of over £600,000, and diamonds at £10,536,326 an advance of nearly two millions. Coal decreased £100,000, but copper—£471,716—was £100,000 better, while tin was £14,000 above last year. "Other minerals" with £399,021 improved £128,000, asbestos and iron ore being chiefly responsible. The value of the asbestos produced up to the end of October was over £290,000, whereas the value for the whole of 1926 was only £216,466. There has been a continual increase in the production of this mineral since 1924 inclusive.

AT the annual meeting of the Institution of Railway Signal Engineers held recently, Mr. W. S. Every, who is the signal engineer of the Metropolitan District and London Electric Railways, was elected President for 1928–1929. The report showed that the Institution had lost five members during the year, whilst there had been 69 new members. The total membership was 712, of whom 197 were overseas.

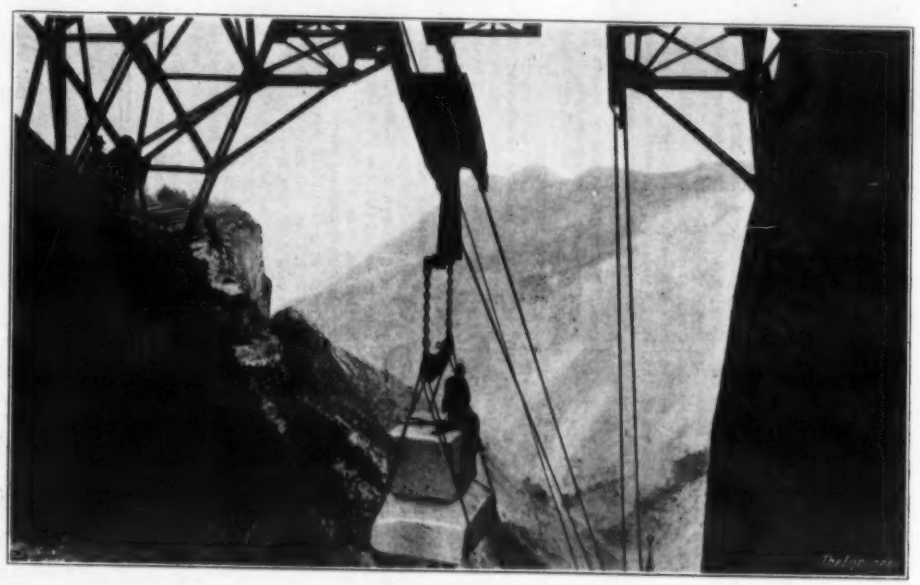


STRETCHES OF LINES ON WHICH RUNNING TESTS WERE CARRIED OUT

AERIAL ROPEWAY AT THE SAGRO QUARRIES, CARRARA

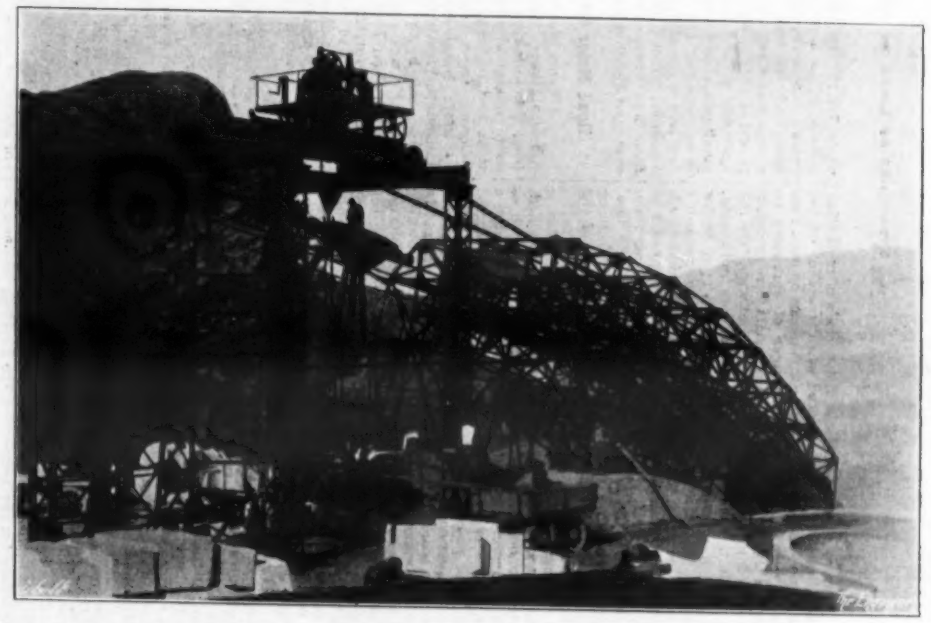
CERETTI & TANFANI, BOVISA, MILAN, ENGINEERS

(*For description see opposite page*)



A 20-Ton Load Leaving Top Station

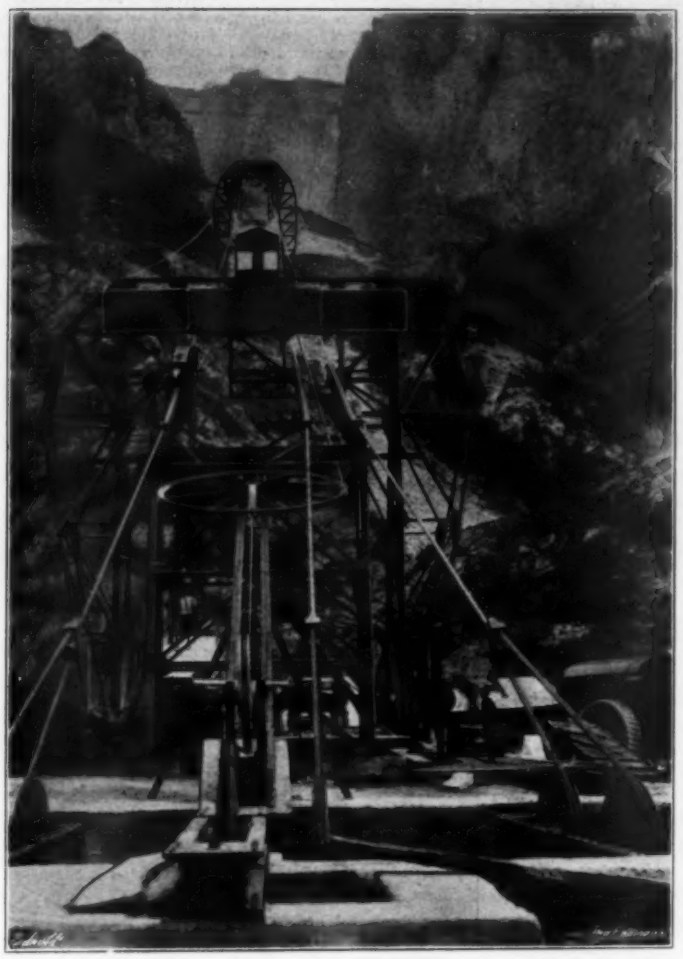
Intermediate Trestle



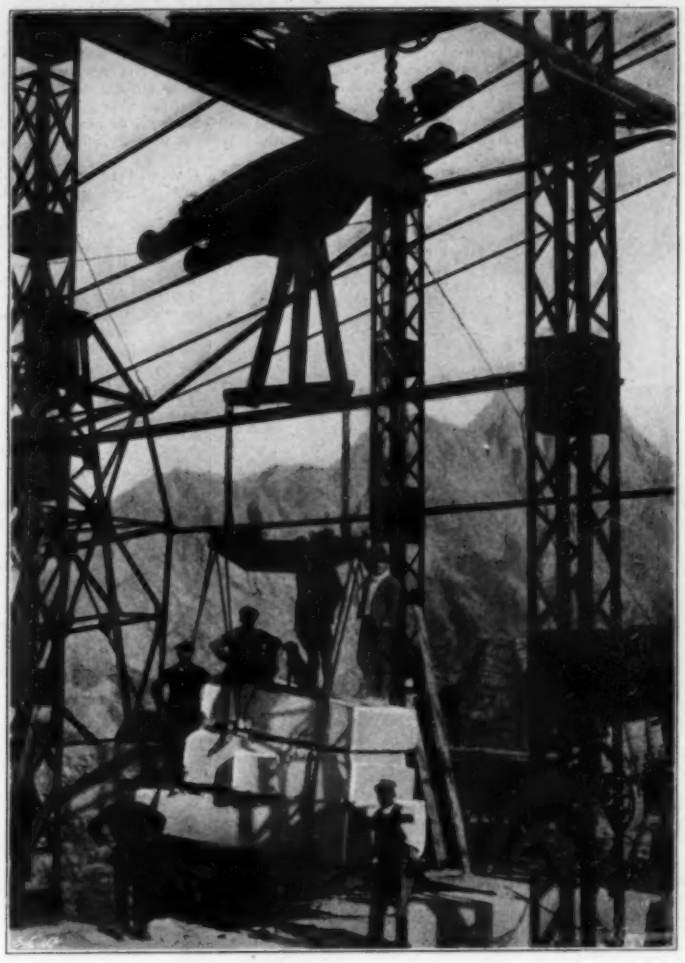
Upper Terminus

Intermediate Trestles

AERIAL ROPEWAY AT A CARRARA MARBLE QUARRY



LOWER TERMINUS



LOADING STATION AT UPPER TERMINUS

Aerial Ropeway at Carrara Marble Quarry.

ONE of the main problems of the marble industry is that of transport from the quarries to the yards. Upon the satisfactory solution of this problem the possibility of profitably working quarries of high-class marble often depends. The mountain range near Carrara (Italy) where statuary marble blocks of the finest quality have been quarried since olden times, presented a serious problem to the owners owing to the altitude of the quarries, and it is only a few months ago that the arduous task of carrying heavy marble blocks from otherwise almost inaccessible parts of the mountains down to the yards at Carrara, was solved by Walton, Goody and Cripps, Ltd., of London and Carrara, owners of the famous Sagro quarries, who employed Messrs. Ceretti and Tanfani, of Bovisa, Milan, to construct the aerial ropeway, which is the subject of this article. In order to understand fully the great difficulties that had to be overcome, it must be noted that the "Sagro," a valley at an altitude of some 3000ft. above sea level, ends abruptly in a precipice with an almost clear drop of 1500ft. A ropeway—built twenty years ago—capable of carrying 6-ton blocks proved insufficient, and heavier blocks had to be brought to the valley on a slipway cut into the face of the mountain, an unsatisfactory and costly procedure. It was therefore decided to join the top of this precipice with the valley by means of a new ropeway capable of carrying loads of 20 tons.

The line has a length of 1600 m. The difference in level between the top and the lower station is 628 m. The line itself is divided in four spans, the biggest of which, between the top station and No. 3, has a length of 1150 m., with a difference in level of 497 m. As the purpose of the line is to carry heavy marble blocks down to the valley, and timber, materials, food, &c., up to the quarries, the "Jig-Back" system was adopted. This consists of two lines of way. The downwards line has two carrying ropes on which the carrier of the capacity of 20 tons runs. The upwards line consists of one rope only, and the carrier is built to carry loads up to 10 tons. The carrying ropes are of the Hercules type, 60 mm., 19 strands, each of 12 crucible steel wires. The factor of safety is, under the most dangerous conditions, 3·5.

Each rope is in two pieces joined by a special device. The ropes are anchored at the upper station to an iron structure, which is embedded in a monolithic block of concrete weighing about 700 tons. This block is joined by reinforced concrete to the foundations of the engine-house, representing a total weight of 2000 tons. At the lower terminus the carrying ropes are each fixed to a weight of 58 tons, which maintains the tension on the ropes uniform. The counterweight moves concurrently with the movement of the cargo along the line in a specially constructed well 18 m. deep hewn out of the live rock. The extreme movement of the counterweight is 10 m., corresponding to a variation of 65 m.—in the widest span—between the sag of the unloaded rope—30 m.—and that of the loaded rope—95 m.—in the centre of the span.

The carriers are connected on one side with the traction rope which passes round the winch at the top station, and on the other side with the ballast rope, which passes round the pulley of the slide at the lower station. By this arrangement a counterweight of 8 tons maintains a constant initial tension to ensure the necessary friction between the traction rope and the pulley on the winch. The traction rope is 46 mm. diameter, and consists of 222 crucible steel wires of 2·15 mm. with hemp core. It weighs 7 kilos. per metre. The factor of safety under the most unfavourable conditions is 5·5. The ballast rope is 24 mm. diameter, made of 72 stranded crucible steel wires with hemp core. The plant is built to carry 20 tons downwards, and at the same time 5 tons upwards, and in the following trip 10 tons downwards and 2·5 tons upwards. It is, therefore, self driven, but a 50 H.P. motor has been installed to meet variations in loading arrangements and for starting. The normal speed of the traction rope is 80 cm. per second, and allowing time for loading and unloading one trip can be completed in one hour.

The carriers are of two different types. That designed for 20-ton loads, which runs on the two carrying ropes, is provided with sixteen cast steel wheels on eight axles. A compensating gear is fitted to the axles. The frame is built up and is fitted with special tackle for the fastening of the traction and ballast ropes. The central axle is provided with a special device, so that it remains in a constant horizontal position under any inclination.

The three supporting trestles—well seen in one of the engravings—are of the archway type and rest on heavy foundations of concrete. Steel shoes are fixed on top for the guides of the carrying ropes, and roller gear is fixed below the shoes for guiding the traction and ballast ropes.

The driving installation is placed in a special building at the top station. The winch has two sets of spur gear with arrangements for hand and automatic brakes. The diameter of the pulley is 2½ m., and there are two leather-lined sheaves, one on each side. At the upper station the traction rope winds round one of the leather-lined sheaves, passes over another pulley—2½ m. diameter—whose axle is slightly inclined in respect of the toothed wheel axle, and leaves the engine-room over the second leather-lined sheave.

Special attention has been given to the braking system. The power generated by the descending loads is absorbed by an hydraulic regulator, whose principal component is an oil pump which can absorb up to 100 H.P., the power produced by a descending block of 20 tons. For the cooling of the oil a continuous water circulation, at the rate of one litre per second, is necessary, and for this purpose a special reservoir of the capacity of 12 cubic metres has been constructed.

There is further a jaw brake which acts by hand or automatically, and finally a safety brake. The latter, also a jaw brake, is an arrangement of levers mounted on the spur wheel gear which acts through counterweights either by hand or automatically. If, for instance, the load has reached the bottom station and the rope has not been stopped, through inattention of the operator, the counterweights unhook themselves and arrest the motion of the rope, as well as stopping the electric motor. The engine-room is 10 m. by 13 m. In it an indicator installed in front of the operator enables him to follow exactly the course of the ascending and descending carriers, which, by the nature of the ground, are not visible to the eye.

The accompanying engravings and those on page 180 give a clear idea of the magnitude of the enterprise and the unusual difficulties that had to be overcome in the construction of this ropeway.

An Improved Mercury-Contact Manometer.

FOR some considerable time past experimental developments have been in progress at H.M. Dockyard, Portsmouth, in connection with a novel type of mercury contact manometer apparatus. These developments, for which patents have been taken out, have been made in accordance with proposals originally put forward by Mr. Harold Martin, Senior Electrical Engineer at that dockyard, who, moreover, has been primarily responsible for the work involved. The original purpose of these developments was to provide remote reading apparatus suitable for measuring the variation in level of water contained in certain tanks of submarines, which are used to affect the trim and buoyancy of the vessels, more particularly as concerns operations associated with submergence.

It is obviously of first-class importance, from a safety standpoint, that the officer in charge of a submarine should have, under his direct observation in the control position, instruments which will accurately keep him informed regarding the depth or quantity of water in his buoyancy tanks, and it is to meet such a requirement that the "Martin" apparatus was, in the first instance, devised. Incidentally, however, we may remark that the apparatus, though worked out originally for this specific purpose, is claimed to be equally applicable in numerous other directions.

The apparatus comprises two distinct parts, which may be conveniently designated "transmitter" and "indicator" respectively. The transmitter is permanently fitted inside the tank, the depth of water in which it is desired to measure. The indicator, which is connected to the transmitter by means of a heavily insulated two-core cable, may be fixed in any desired position and at any distance away from the tank. The transmitter is fixed in the lowest possible position in the tank, as is shown diagrammatically in Fig. 1, and proceeding upwards from it is a standpipe having at its summit—which is arranged at approximately the same level as the highest point that can be reached by the water in the tank when it is full—an open vessel with a comparatively large area the purpose of which will be explained in due course.

The transmitter, which is a mercury U tube manometer of special construction, is illustrated in the sectional drawing given in Fig. 2. It consists of a base of cast iron closed at the top by a cover which, in conjunction with a

Dermatine joint, makes the base water-tight. In this base there are sunk two compartments of unequal size, which are entirely distinct from one another. In the cover there are three openings, one arranged over the smaller compartment and two over the larger compartment. That over the smaller compartment and one of those over the larger compartment are, respectively, for the reception of one of the legs of an inverted U tube. Actually, the two legs are separate tubes, which are led down well into the compartments in the base, as will be seen in the drawing, and the U is completed by means of a cast iron cap or yoke with machined holes in it for the reception of the tops of the tubes. The joints between the tubes and the cap and between the tubes and the base cover are plumbed to

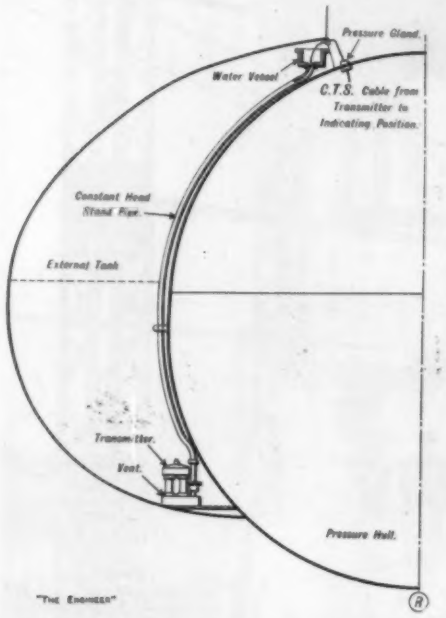


FIG. 1—MANOMETER IN SUBMARINE BUOYANCY TANK

make them water and air-tight. Into the third hole in the base cover is screwed the bottom end of the standpipe, of which mention was made above.

Arranged inside and throughout the whole length of the leg of the U tube which is adjacent to the standpipe is an ebonite former on which is wound, with a fine pitch, a continuous coil of bare nickel-chrome resistance wire of small diameter. The former is kept central in the tube by means of a special adapter. A central hole runs from top to bottom of the former and up it is passed a heavily insulated flexible wire, the bared end of which is metallically connected to the top end of the coil on the former, the junction beng made in a cavity arranged in the upper part of the latter, which is subsequently filled in with paraffin

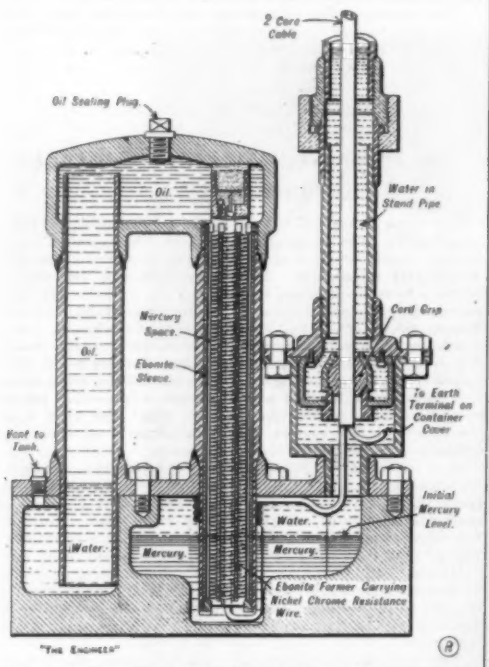


FIG. 2—THE MARTIN MERCURY CONTACT MANOMETER

wax so that it is thoroughly insulated. The flexible wire forms part of the two-core cable, which is brought down into the base through the standpipe. Its companion wire is connected to a terminal on the base and forms the return lead of an electrical circuit to which we refer later.

The larger compartment in the base is filled up to a certain level with mercury, the level being such that the lower end of the tube containing the resistance coil is submerged for some distance below the surface. The interior of the tube is lined with an ebonite sleeve, the bore of which is of such diameter that only a small annular space remains round the coil of wire on the former.

With so much description we can proceed to describe the working of the apparatus. Through the hole at the top of the yoke connecting the two legs of the inverted U tube is poured shale oil of a special quality until both the legs and the yoke itself are completely filled. During this process the vent in the cover plate at the left-hand side is plugged. The oil in the right-hand leg—that containing the resistance—will, of course, impinge on the surface of the mercury inside the tube. When the oil filling is over the plug is replaced and screwed tightly home.

Water is then poured into the large-diameter vessel at the top of the standpipe until not only is the space at the top of the mercury in the larger compartment in the base filled with water, but the standpipe and the vessel at the top are also filled. The apparatus is then ready for use. At first, of course, the buoyancy tank is empty. When the vent plug in the cover of the base of the transmitter is removed the pressure of the column of water in the standpipe will be unbalanced and consequently the mercury will be forced up inside the leg of the U tube which contains the resistance coil until equilibrium is brought about by the weight of the mercury in the tube balancing the weight of the water in the standpipe. As the cubic contents of the vessel at the top of the standpipe is large when compared with the volume of mercury forced up into the tube, the level of water in it will only be very slightly lowered, so that, practically speaking, the top level of the water in the standpipe, and hence, of course, the pressure exerted by the column of water, will, to all intents and purposes, remain constant throughout the full range of rise and fall of the mercury in the tube. It may be explained that the dimensions of the apparatus are such that, in order to balance the column of water in the standpipe, the mercury will rise in the tube, nearly but not quite to the top of the resistance coil.

When as we have just described it, the transmitter will

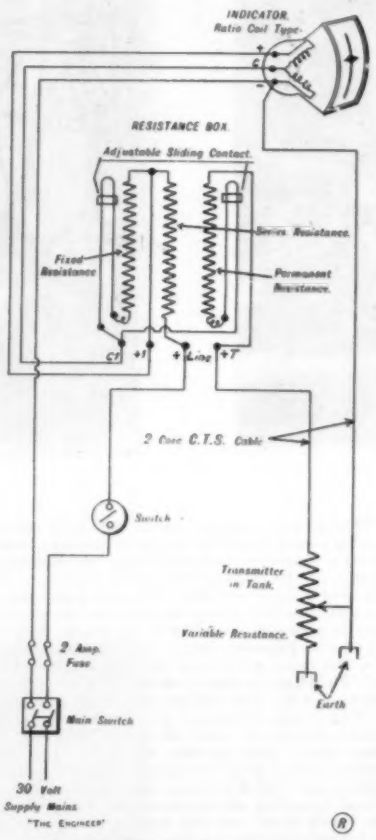


FIG. 3—ELECTRICAL CONNECTIONS

be in a condition exactly similar to that which it will assume when the buoyancy tank is empty. During the process of pouring in water a certain quantity of oil will be forced out of the vent. As soon, however, as equilibrium is brought about no further oil will escape.

Now let us suppose that water is admitted to the buoyancy tank. Since the vent hole in the transmitter is open, as soon as the level of the water rises above it—which, as the apparatus is right at the bottom of the tank, means as soon as any water is let into the latter—pressure is brought to bear on the oil through the vent and, immediately, the balance in the apparatus is upset. The result is that, as the water level in the tank rises, the pressure due to the column of water in the standpipe is gradually counteracted, and the mercury in the leg of the U tube falls until, when the level of the water in the tank has arisen to the same height as the vessel at the top of the standpipe, so that the pressures on each side of the apparatus are the same, the mercury has receded from the tube down to the level of the mercury in the compartment in the base. It will be understood that the space in the base that was occupied by oil when the apparatus was first put to work is, under the new conditions, occupied by water, the oil, with its lower specific gravity, being forced up in front of it.

Let us now consider what happens during the series of events we have outlined. As the mercury rises and falls in the tube containing the resistance coil, more or less of the coil, as the case may be, is short circuited by the mercury. Supposing, now, that an electric current be passed between the two terminals of the instrument—which is practically the same thing as between the two ends of the resistance coil—it is evident that the current flowing in the circuit will vary in accordance with the amount of resistance which is short circuited by the mercury. When the buoyancy tank is empty the mercury will be forced up the tube and the maximum amount of resistance will be cut out. When the tank is full the mercury will fall to the same level as that in the compartment in the base, and the maximum amount of resistance will be in circuit. In the first case the current passing in the electric circuit will be at a maximum; in the second case at a minimum. Between the two extremes the resistance in the circuit, and hence the amount of current flowing, will vary directly as the level of water in the tank. It is easy to understand, therefore, that with a suitable indicator, properly calibrated, it is possible to know at any moment exactly what depth of water there is in the tank. We are informed that with the indicator which is actually employed a difference in level of the height of the mercury of as little as one-hundredth of an inch is easily read. That would mean that a difference in level of the water in the tank of approximately one-seventh of an inch could be detected.

We now come to the second portion of the apparatus—the indicator—which is simply an electrical instrument of the Evershed and Vignoles ratiometer type, which, with its accessories that include resistances, some of which are variable, may be fitted at any desired point. A diagram showing the connections is given in Fig. 3, from which the working will be readily understood. The only additional adjunct required is a source of electrical energy; 30 volts is the pressure chosen by the inventor, and the consumption of electrical energy may, we gather, be kept as low as 5 watts.

We have hitherto spoken only of buoyancy tanks, but we may say that the system of depth measurement is equally applicable to the fuel oil tanks of submarines.

The following special claims are made for the apparatus:

(1) It is simple in construction.

(2) As the resistance coil is always in mercury no electrical make or break is involved and a continuous graduation is obtainable.

(3) It is accurate and sensitive in operation and is independent of voltage variation or alteration of static pressure, the latter because both ends of the manometer circuit are always at the same pressure.

(4) It utilises no floats, glands, air or compressible fluid of any kind and no interconnecting pipes.

Furthermore, we are informed, that it has been, or can readily be, adapted for use for the following purposes, in addition to submarine tank measurement:—(*a*) General depth indicating purposes for floating or other docks, reservoirs and tanks of all kinds; (*b*) a boiler water level indicator; (*c*) a ship's draught or displacement measuring apparatus; (*d*) a remote reading tide gauge; (*e*) boiler steam, air or gas flow measurement; (*f*) for measuring the flow of water, brine or other liquids.

A licence to manufacture and sell apparatus made in accordance with Mr. Martin's patents has been secured by George Kent, Ltd., of Luton and London, and that firm,

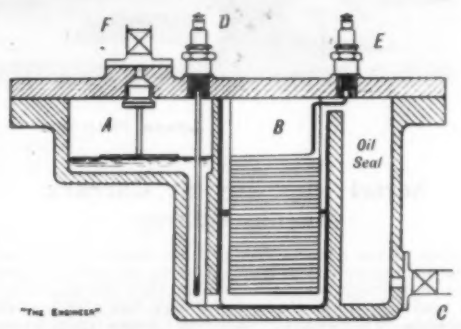


FIG. 4—MANOMETER FOR FLUID FLOW MEASUREMENT

while it is in a position to supply tank depth measuring apparatus substantially of the same type as that evolved at Portsmouth to meet Admiralty requirements, has devoted its attention more particularly to the commercial development of alternative equivalent apparatus for fluid flow measurement.

It has recently put on the market what it terms its "Telerecorder Type M.C.T.," which is intended for recording the flows of various fluids. This apparatus includes a transmitter and a recorder of a character similar to that used for submarine tank work. The action of the transmitter is shown diagrammatically in Fig. 4. There are two mercury chambers A and B, which have a communicating passage between them at the bottom. Chamber B is also in communication, through an oil seal, with the upstream cock C, and it contains an ebonite former upon which fine resistance wire is wound. Chamber A is of larger size than chamber B, and it contains a float-operated overload valve and a contact rod and terminal D, which provides the return path for the electric current, the other end of the circuit being at terminal E. The cocks C and F are connected to the upstream and downstream pressure holes respectively of the Venturi tube or of the orifice.

When a differential pressure is created by the Venturi tube or orifice the mercury in chamber B is depressed—for instance, as shown in the diagram—so that part of the resistance wire on the former is uncovered. That causes the resistance between the terminals D and E to be increased and in that way an electrical effect which has a relation to the change of flow of the fluid being measured is produced. It will be readily understood how that effect may be employed for indicating or recording purposes.

In connection with this apparatus Mr. Martin has drawn our attention to a discovery which was made during the early days of the experiments with mercury contact, and which, he points out, makes the instrument particularly suitable for steam flow measurement. The discovery was:—(*a*) That the electrical contact which mercury makes with a solid conductor immersed in it, is directly dependent upon the static pressure to which it is subjected, which pressure forces it into contact with the conductor; and (*b*) that, whereas at about atmospheric pressure, there is appreciable irregularity and uncertainty with regard to the electrical contact effects, that irregularity is, at a pressure of about two atmospheres, very greatly reduced, while at the high pressures associated with modern boiler practice, complete uniformity and reliability in electrical contact effects are ensured.

Railway Matters.

SPEAKING at the annual dinner of the Permanent Way Institute on January 28th, Mr. G. Ellson, chief engineer of the Southern Railway, the new President, said that British railways spent £13,360,000 yearly on the renewals and repairs of the permanent way, nearly three-fourths of which went on repairs. To carry out that work 58,600 men were employed, exclusive of the supervising staff. The latter numbered some 800 and 900 men.

THE question of a direct broad gauge connection between Agra and Karachi is being investigated afresh. The scheme was surveyed in 1919 and again in 1922, but the conditions then prevailing were not considered propitious. It is now proposed to re-examine the problem in the light of present-day conditions, and to take into consideration the trade developments which are likely to occur and may influence the flow of trade between Karachi and the United Provinces on the completion of the Sarda Canal and the Sukker Barrage projects.

RADIOPHONE control of moving freight trains was given a practical demonstration on January 26th in the operation of a train of 111 cars from the Selkirk train yards, near Albany, to Utica, on the New York Central Railroad. Throughout the 95 miles of the run the conductor in the "caboose" at the rear end of the mile-long train was in constant radiophone communication with the driver in the cab of the locomotive. The equipment, which was designed by engineers of the General Electric Company, operates on a wave band of 109 m. to 130 m., does not interfere with broadcast listeners, and has, it is said, an effective range of about 5 miles.

OUR American contemporary, *Railway Signalling*, reports that on July 1st last all, except the Chicago and Alton—now nearly finished— of the installations of automatic train control on the railways of the United States, ordered by the Interstate Commerce Commission in June, 1922, were completed. The order applied to one section on each of forty-four systems, and covered 3893 locomotives and 7647 track miles. A second order was issued in January, 1924, which applied to thirty-six systems and covered 3060 locomotives and 7539 track miles. All but four of these have been finished. Moreover, four systems have made further installations than those ordered by the Commission.

WORK on the electrification of the Paulista Railway Company's lines in Brazil between the junctions of Rio Claro and Rincao, *vid* San Carlos and Araraquara, a total distance of 152 kiloms., 5ft. 3in. gauge, is to be continued, the company having received the necessary official authority. Additional rolling stock may also be ordered from the same manufacturers—the International General Electric Company—which supplied that in present use. This latter comprises locomotives for passenger traffic weighing 121 tons, of 2000 H.P.—voltage 3000—and a maximum speed of 65 m.p.h.; and goods locomotives, weighing 87 tons, of 1500 H.P. at the same voltage, and a maximum speed of 40 m.p.h.

IN reporting on a fatal accident, some months ago, to a signal ganger, who was supposed to be acting as a look-out man, Mr. Scott Main, of the Ministry of Transport, said, in his report, that it was a question as to whether the man was actually appointed to act as such. The man in charge was responsible for seeing that the look-out man was provided with the necessary equipment for his duties, that he was stationed in a suitable position and wearing a distinctive badge. This man was not, however, wearing the look-out man's armlet nor his badge, which, Mr. Main remarks, is a most important feature, as "it has a moral effect upon the wearer as to the responsibility of his occupation; it clearly indicates that protective measures have been taken and locates definitely where they rest, and the importance of this feature cannot be too strongly stressed."

FOLLOWING our paragraph of December 30th as to the main line companies and the proposed pooling of London traffic receipts, it may be remarked that the memorandum therein referred to has led to a very satisfactory meeting of representatives of the companies and those of the London Traffic Advisory Committee. The companies do not object so much to the proposed pooling of receipts as they can show what proportion they earn. They are concerned, however, over the demand for common management, and they recommend a council, representative of all interests, which shall be under a statutory authority and co-ordinate the various activities of main line companies, the Underground railways, the omnibuses and trams. As there is little prospect of any legislation of such a character being considered during the present session, there is ample time for the question to be quietly and thoroughly thrashed out.

THE limits on our space prevented us, when dealing last week on the Seven-Day Journal page with Colonel Mount's report on the Den of Cowie Viaduct derailment, mentioning an important recommendation made by that officer. It should, first, be known that the former Board of Trade Requirements for New Railways ordered that "On important viaducts . . . substantial outside wheel guards should be fixed, above the level of and as close to the outer rails as possible." It should be noted that the guard rails were to be fixed on the outside, and thus in distinct contrast to American practice, where the guard rails are in the four-foot and about 8in. from each rail. They are extended in America to from 60ft. to 150ft. from the end of the bridge and gradually deflected to meet in the centre of the track, and thus may possibly put any derailed vehicles nearer to the rails and perhaps help to re-rail them. When the Ministry of Transport issued its new Requirements in March, 1925, the clause in question was found to read:—"On all important bridges and viaducts, where necessary, substantial wheel guards and check rails to be fixed above the level of and as close as possible to the rails." As now ordered the guards may be either inside or outside, and Colonel Mount points out that the Den of Cowie Viaduct derailment illustrated the measure of additional risk which existed owing to the absence of wheel guards. He adds that, in addition, the splaying of such guards, in rear of the structure on either side, is advisable, in order to assist vehicles which may have become derailed before the structure is reached to follow the alignment of the track.

Notes and Memoranda.

THE Chinese Government Bureau of Economic Information has started to publish, in its *Bulletin*, a glossary of Chinese building terms written in English and five native dialects, which may be of interest to manufacturers supplying that country with materials.

THE most effective arrangement for the condensing surface of ammonia condensers is, according to investigations carried out in America, one in which the length of gas travel is reduced to a minimum, and a maximum amount of surface is exposed to the coldest water.

ACCORDING to the returns issued by the Ministry of Health, more concrete houses were erected in this country during 1927 than in any year since the subsidy was introduced. Forty-one thousand two hundred and seventy-seven concrete houses have now been subsidised by the Government, of which 18,373 were completed last year.

THE Bucks Creek hydro-electric power plant, which is being built on the Feather River, California, will have an exceptionally high head. It will be equipped with two 35,000 horse-power impulse turbines working under a head of 2561ft. Included in the project are the construction of 18 miles of roads, a 10-mile railway, a 4800ft. incline, several dams, two tunnels, 8 miles of welded pipe, various headworks, a surge chamber, penstocks and power house.

GEOPHYSICAL methods of prospecting for mineral deposits are in reality an aid to the geologist in supplementing his knowledge, and are in no way a substitute, declares the United States Bureau of Mines, in a review of various methods of this nature now being employed in the search for valuable mineral reserves. The best methods to use at any particular place will depend upon the geological structure of the region, and the type of mineralisation for which one is looking.

IN a bulletin of the University of Illinois, by F. R. Watson, on the absorption of sound by materials, it is stated that a very important consideration is the painting or decoration of materials. If such painting closes the pores of the material, or if painting a membrane stiffens it, the absorbing efficiency is reduced. The effect of spraying paint is not as serious as that of applying it with a brush. For instance, cork boards with rather large openings in the surface may be sprayed without appreciable effect.

IT is reported from Washington that a new 3in. anti-aircraft gun and mobile mount, considered by military men to be the most advanced weapon of its kind, has been designed by the Ordnance Department of the United States Army and adopted by the War Department. The new weapon is capable of firing 25 shots a minute almost three miles vertically, and its horizontal range is more than twice that distance. Its mobile carriage is said to combine stability and mobility, and it can be emplaced from carrying position in readiness to fire in fifteen minutes. It is so light that it can be towed across the country by a standard four-wheel drive truck. The gun itself is of ·50in. calibre, and made in two parts, an outer barrel and an inner removable tube. It is stated that the tube can be installed at the firing front in a few minutes by the gun crew and that its cost is small.

THE trials of a miniature "Oceanoglissuer," invented by M. Adrian Remy, created some sensation when they were carried out at Suresnes. It is now reported from Paris that, since that time great progress has been made with the construction of a full-sized vessel which, its inventor hopes, may make the crossing from Cherbourg to New York. Its speed should be 40 knots. The new "Oceanoglisseur" will consist of two metal floats, made in the form of cigars, 68ft. long, and with a diameter of 6ft. 6in. at the widest part. These floats will be linked together by a metal cabin, somewhat like a shell, which will measure only 30ft. by 7ft., and will contain stores of food and a pilot's seat forward, a living-room in the centre and wireless installation at the stern. The petrol and oil will be carried in the floats, which in that part not occupied by tanks will be filled with cork and kapok to ensure buoyancy.

THE chemist of the Geological Department of the Federated Malay States has obtained some interesting results in connection with magnetic cassiterite, that is, tin ore containing so much iron in chemical combination that it is lifted by an electro-magnet. That such cassiterite exists has been known for a long time, but in view of the growing use of magnetic separators in dressing concentrates, miners would be well advised to have the magnetic portions examined in order to avoid possible loss. The chemist reports as follows concerning a sample of tin ore submitted from a mine producing tin ore on a large scale: "The average assay of the sample was 77·1 per cent. metallic tin; it contained 16·68 per cent. of magnetic ore and 83·32 per cent. non-magnetic. The magnetic ore assayed 77·6 per cent. metallic tin and the non-magnetic 77·0 per cent. metallic tin." The higher assay value of the magnetic portion may be due to non-magnetic impurities, such as zircon, being left with the non-magnetic portion.

EXPERIMENTS have been successfully carried out in the Science College, Calcutta, which are claimed to open up practically limitless possibilities of producing power alcohol and other products from sawdust and water hyacinth. Professor H. K. Sen, who conducted the experiments recently, stated, in an address before the Indian Science Congress, that 40 gallons of absolute alcohol had been obtained from a ton of gangwa sawdust, while trials with trees in other countries had yielded only about 50 per cent. of that quantity. "The gangwa tree grows wild in the Sunderbans and is the cheapest fuel obtainable in Bengal. As it is a fast grower a perennial supply could, it is said, be maintained by the Forest Department. Water hyacinth, which is a pest in Bengal waterways, has also been shown to have similar potentialities. A hundred maunds of it dried are said to have yielded 12 maunds of pure potassium chloride, 35 to 40 gallons of spirit and about 20 maunds of pulp, which can be converted into straw-boards. The utilisation of the pest would have very desirable results, as it would help to clear up the Bengal waterways, in addition to furnishing important commercial products.

Miscellanea.

WHEN the new extensions of the Norwegian Norsk hydro-electric plant have been completed, there will be an annual exportable output of 900,000 tons of nitrogen.

A NEW plant for the manufacture of sulphate of ammonia, to the extent of 100,000 tons a year, by the Fauser process, is to be put up at Willebroeck, Belgium.

A PAPER pulp mill with a capacity of 120 tons a day is to be erected at Tacoma, Washington, at a cost of 3,000,000 dollars. Saw-mill waste and the sulphite process are to be employed.

A NEW gas generating plant is to be constructed at Smithy Wood, near Ecclesfield, for Thorncliffe Coal Distillation, Ltd., It will comprise fifty-nine Becker regenerative ovens, built by the Woodall Duckham Vertical Retort and Coke Oven Construction Company. They are intended to carbonise approximately 450,000 tons of coal per annum.

A DEPARTMENT of agricultural engineering has been established at the Ontario Agricultural College at Guelph—superseding the former departments of Physics and Manual Training—with a view to teaching the farmers the advantages accruing from the use of modern machinery. The courses of the new department include petrol engines, electricity, forging, hydro-electric power on the farm and rural sanitation.

WHAT will rank as one of the longest bridges on the whole of the African Continent is about to be constructed across the river Benue at Makurdi, 290 miles inland from Port Harcourt on the Eastern Division of the Nigerian Railway. The bridge will comprise thirteen spans with a total length between abutments of 2584ft. The contract for the whole of the works has been awarded to Sir William Arrol and Co., Ltd., of Glasgow.

THE death occurred on Sunday, February 12th, at Redruth, of Mr. George Eliot Phillips, resident engineer of the Victoria Falls Power Station, Rosherville, Johannesburg. Mr. Phillips came home with his wife and family in May last, intending to return to South Africa in October. He served his apprenticeship with the Tuckingmill Foundry Company, and had spent twenty-five years in South Africa, during nineteen of which he had been resident engineer at the Victoria Falls Station.

SEVERAL important irrigation schemes have been put forward in Kolhapore State, India. The biggest is what is known as the Kasari scheme, under which a catchment area of nearly 150 square miles would be formed by a dam to be constructed across the Kasari River at Bhogaon. The minimum proposed height of the dam above the bank level is 80ft. The length of main channel would be about 30 miles with two branch canals, each of about the same length. The scheme would irrigate about 15,000 acres, and the total cost would be about 60 lakhs of rupees.

FROM the monthly return of the National Federation of Iron and Steel Manufacturers, we learn that the number of furnaces in blast at the end of January was 148, a net decrease of one since the beginning of the month, nine furnaces having gone out of operation and eight having been put into blast. The production of pig iron in January amounted to 560,500 tons, compared with 559,100 tons in December and 575,900 tons in November. The production includes 190,000 tons of hematite, 198,600 tons of basic, 128,700 tons of foundry, and 23,200 tons of forge pig iron. The production of steel ingots and castings in January amounted to 626,200 tons, compared with 604,900 tons in December and 698,700 tons in November.

IT is reported from Rangoon that a scheme for water and electric power supply combined has been recommended by a London firm which has submitted a preliminary report after a detailed survey of the Yunzalin scheme for a water supply for that city. The proposed scheme is known as the Pygawpu scheme, and the estimated cost of it in its first development stage is 11 crores of rupees. The estimated additional cost for the second development stage is 5 crores 30 lakhs. It is pointed out that the discharge of the Thelaw Klo, a tributary of the Yunzalin River, properly impounded at its exit from the Pygawpu Valley, would yield sufficient water to meet the requirements of Rangoon to the end of the present century. The capacity of the hydro-electric power plant would be 13,500 and 27,000 kW during the first and second development stages respectively.

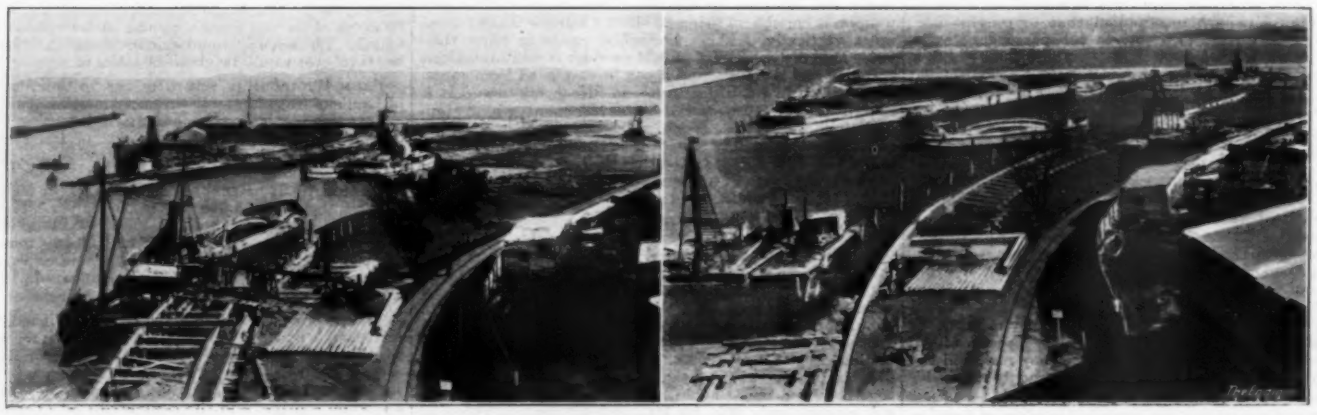
THE honorary members' lecture to the Junior Institution of Engineers for the session was given on February 10th by Professor H. P. Philpot, who took as the subject of his address "Some Principles of Investigation in Engineering Work." Professor Philpot said that general investigation work in engineering should always be approached in the spirit of the purest research work, such as was carried out with the sole object of determining some principles or facts with respect to the laws of nature which might possibly be of some interest or general use. The work might ultimately prove to have a commercial value or not, but it should be done with the object of finding out the truth. Truth paid in the long run, although for a time a half-truth or a doubtful result might appear to have some advantages. It was essential that a problem should be approached with an open mind.

THE Colombian Ministry of Public Works will shortly place a contract for important improvement works at the port of Cartagena, on the Caribbean Coast, considered to be the best harbour on the north coast of South America. The harbour is formed by a natural deep indentation of the coast line, shut in by two long islands lying parallel to the mainland, which affords deep and secure anchorage. The work will include the widening of the harbour at its mouth and the deepening of the channel leading through Cartagena Bay to afford access to the largest vessels visiting the port. The absence of modern quays has hitherto prevented vessels from approaching within a mile of the landing stages, the long railway pier on the mainland opposite alone permitting of vessels mooring alongside. There is keen competition for this contract between representatives of various European and United States firms, since it is understood that the successful contractor will not be required, as in many previous cases, to contribute any capital towards the carrying out of the project.

GISBORNE, NEW ZEALAND, NEW HARBOUR WORKS

(*For description see page* 174)

FIG. 2—VIEW OF THE TOWN BEFORE THE NEW WORKS WERE BEGUN



FIGS. 3 AND 4—STAGES IN THE FORMATION OF THE DIVERSION CUT

FIG. 5 UPPER, OR LAND, END OF DIVERSION CUT